DOCUMENT RESUME

ED 355 256 TM 019 597

TITLE	Alternative Assessments in Math and Science: Moving toward a Moving Target. A Joint Study.
INSTITUTION	Appalachia Educational Lab., Charleston, W. Va.; Virginia Education Association, Richmond.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	Oct 92
CONTRACT	RP91002002
NOTE	78p.
AVAILABLE FROM	Appalachia Educational Laboratory, Resource Center, P.O. Box 1348, Charleston, WV 24325 ($9); Director of Instruction and Professional Development, Virginia Education Association, 116 South Third Street, Richmond, VA 23219 (VEA members only).
PUB TYPE	Reports - Evaluative/Feasibility (142)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Educational Assessment; Educational Change; Educational Planning; *Elementary School Teachers; Elementary Secondary Education; Guidelines; *Mathematics Achievement; Mathematics Tests; Science Tests; Scoring; *Secondary School Teachers; Student Evaluation; *Teacher Made Tests; Thinking Skills
IDENTIFIERS	*Alternative Assessment; *Performance Based Evaluation; Science Achievement

ABSTRACT

Given the restructuring of curriculum and instruction and the changing state of assessment in Virginia and nationally, a study group of 22 Virginia teachers from elementary schools, middle schools, and high schools throughout the state chose to examine and revise their assessment practices. They wanted to reflect changes in thinking and practice in teaching that include active learning, cooperative learning, and critical thinking strategies. After 6 months of developing and implementing alternative assessments in their classrooms, study group members concluded that implementation strategies should include: (1) planning assessment as instruction is planned; (2) having a partner with whom to share ideas; (3) developing generic rubrics; (4) expecting to learn by trial and error; (5) attempting student peer assessment; and (6) using cooperative grouping for completing assessment tasks. In addition to findings in the areas of student achievement, student attitudes, instructional practice, and teacher effectiveness, 22 sample activities for alternative assessment with scoring rubrics and an 85-item bibliography are provided. Eleven tables illustrate the discussion. Seven appendixes contain technical details, a glossary, and criteria and recommendations for alternative assessment. (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED355256

Alternative Assessments in Math and Science: Moving Toward a Moving Target

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

A Joint Study by the

VEA
Virginia Education Association
116 S. Third Street
Richmond, Virginia 23219

and

AEL
Appalachia Educational Laboratory
P. O. Box 1348
Charleston, West Virginia 25325

October 1992

Funded in part by

OERI
Office of Educational Research and Improvement
U.S. Department of Education

TM019547

BEST COPY AVAILABLE

Alternative Assessments in Math and Science: Moving Toward a Moving Target

A Joint Study by

VEA

Virginia Education Association

and

AEL

Appalachia Educational Laboratory
Charleston, West Virginia 25325

October 1992

Funded in part by the

OERI

Office of Educational Research and Improvement
U. S. Department of Education
Washington, D. C.

The Appalachia Educational Laboratory (AEL), Inc., works with educators in ongoing R & D-based efforts to improve education and educational opportunity. AEL serves as the Regional Educational Laboratory for Kentucky, Tennessee, Virginia, and West Virginia. It also operates the ERIC Clearinghouse on Rural Education and Small Schools. AEL works to improve:

- professional quality,
- curriculum and instruction,
- community support, and
- opportunity for access to quality education by all children.

Information about AEL projects, programs, and services is available by writing or calling AEL, Post Office Box 1348, Charleston, West Virginia 25325; 304/347-0400; 800/624-9120 (toll free), and 304/347-0487 (FAX).

This publication is based on work sponsored wholly or in part by the Office of Educational Research and Improvement, U. S. Department of Education, under contract number RP 91002002. Its contents do not necessarily reflect the views of OERI, the Department, or any other agency of the U. S. Government.

AEL is an Affirmative Action/Equal Opportunity Employer.

Help Us Improve AEL Publications

Readers are requested to complete the product evaluation form included within and to fold, stample, and return it to AEL. Suggestions for future AEL publications are welcome.

TABLE OF CONTENTS

Section	Page
Acknowledgements	iv
Executive Summary	vi
Introduction	i
Planning the Study	i
Conducting the Study	i
Rationale	3
Problems With Current Assessment Practices	3
Purposes of Assessment	3
Guidelines for Authentic Assessment	4
Myths About Alternative Assessment	7
Findings of the Study	11
Student Achievement	11
Student Attitude	18
Instructional Practice	22
Working Conditions	23
Teacher Effectiveness	24
Recommendations for Implementation	26
Sample Activities for Alternative Assessment	29
Introduction	29
Elementary Science and Mathematics Assessments	31
Secondary Science Assessments	37
Secondary Mathematics Assessments	46
Bibliography	57

List of Tables

Table 1: Aspects of Evaluation for Effective Classroom Assessment	5
Table 2: Aspects of Instruction for Educational Reform and Performance Assessment	6
Table 3: Kentucky Statewide Assessment Program Performance Levels	8
Table 4: Table of Contents For Science 8 Demonstration File	13
Table 5: Evaluation Rubric for Sixth-Grade Presentation on Acids, Bases, and Salts	14
Table 6: Evaluation Rubric for Student Work on Science/Literature Intregration Project	16
Table 7: Evaluation Rubric for an Art/Science Activity	17
Table 8: Polygon Rubric Written by Ninth Grade Resource Math Students	17
Table 9: Alternative Assessment Design Sheet for a Science Project for the Visually Impaired Student	19
Table 10: Criteria for Assessing the Academic Fair Project	20
Table 11: Report Specifics	21

Appendices 61
A: Article of Invitation to Membership in the Virginia Study Group 63
B: Study Group Member Application Form 64
C: Glossary of Terms for Alteranative Assessment 67
D: Criteria for Quality Alternative Assessement 68
E: Qualitative Assessment Instrument for Findings: Content Category Questions for Consideration by Study Group Members 69
F: Weekly Summary Sheet for Study Group Member Reflection 70
G: Qualitative Assessment Instrument for Recommendations: Five Implementation Questions for Consideration by Study Group Members 71

Acknowledgments

The Virginia Education Association (VEA) and the Appalachia Educational Laboratory (AEL) wish to thank the following study group team members who planned and developed *Alternative Assessments in Math and Science: Moving Toward A Moving Target*. Their time and effort in developing alternative assessments, implementing classroom strategies, recording reflections and reactions, analyzing data, and writing and editing the product have culminated in a document that informs teachers, administrators, parents, school boards, and policymakers about current practices in using alternative assessments in Virginia schools.

Sue Parker and Donna Smith
McLean High School, Fairfax County Schools

Lori Kanode and Cindy Rooney
Central Elementary School, Fluvanna County Public Schools

Charles Jervis and Jennie Reilly
Auburn High and Middle School, Montgomery County Schools

Charmaine Brooks and Gertrude Jones
Westover Hills Model School, Richmond City Schools

Leigh McKay and Bonnie Whitley
William Byrd High School, Roanoke County Schools

John Cannaday, Jr. and Martha Gwen Sibert
Roanoke Valley Governor's School for Science and Technology

Leigh Shiflett and Joandell Ventura
Ashby-Lee Elementary School, Shenandoah County Schools

Donald Grimes and Marjorie Moyers
Stonewall Jackson High School, Shenandoah County Schools

Katherine Moss and Larry Pruitt, Sr.
Richlands Middle School, Tazewell County Schools

Maxine Bayly and Victoria Reid
York High School, York County Schools

Mary Deal and Linda Hite
York High School, York County Schools

Also essential to this project and publication was Helen Rolfe, Director of Instruction and Professional Development for VEA, who helped to guide the study by conceptualizing the project, securing funding, nominating study group members, organizing and facilitating meetings, maintaining communications, providing informational speakers, visiting school teams, reviewing this publication, and promoting the project within the state and nationally.

Special thanks are extended to Carol Mitchell, of the Office of Educational Research and Improvement, U.S. Department of Education and Ruth Mitchell, Associate Director of the Council for Basic Education, who served as external reviewers of this document.

Finally, AEL staff who assisted with project planning, meeting facilitation, study group com-

munications, site visitations, development of study group evaluation instruments, related literature review and dissemination, development of selected publication sections, typing, editing, typesetting, graphic design, and layout contributed greatly to this final product. The authors wish to thank the following AEL staff members:

Rebecca Burns
Carla McClure
Mary Farley
Jane Hange
Carolyn Luzader
Marsha Pritt
Karen Simon
Diana Wohl

EXECUTIVE SUMMARY

Each year Virginia schools, and schools nationwide, administer standardized, paper/pencil tests to all public school students at certain grade levels, and then compile results for the schools, districts or divisions, and the state as a whole. Some purposes of those assessment programs are to provide information that allows educators to judge the effectiveness of their programs, to make improvements in instruction, and to measure and report on individual student learning. Given the restructuring of curriculum and instruction and the changing state of assessment in Virginia and nationally, a study group of 22 teachers from elementary, middle, and high schools throughout the state chose to examine and expand their assessment practices.

During the 1991-93 project, these eleven pairs of teachers sought to revise the nature of their testing to reflect changing thinking and practice in teaching that include active learning, cooperative learning, and critical thinking strategies. They hoped to adopt a new view of the assessment of academic achievement; that is, to define what it means for students to know and be able to demonstrate knowledge. The goal of study group members and their project sponsors—the Virginia Education Association, the Appalachia Educational Laboratory, the National Education Association, and the Virginia Department of Education—was to create and implement more authentic assessments of student learning. The assessments that resulted require students to use skills in real applications, encourage teachers to expand the scope of their instructional and assessment strategies, and motivate students to reach high levels of achievement.

Today's employers often express the need for employees who can think critically and work collaboratively to solve problems. If one goal of schooling is to assist students in becoming self-directed learners, collaborative workers, complex thinkers, quality producers, and community contributors, teachers must be able to effectively assess their progress toward those outcomes and to adjust the instructional process to ensure achievement at high levels. Alternative assessment may offer a solution to the dilemma of monitoring and facilitating learning in a realistic and meaningful manner.

After six months of developing and implementing alternative assessments in their classrooms, study group members concluded that implementation strategies should include:

- planning assessments as instruction is planned,
- having a partner with whom to share ideas and reflections,
- developing generic rubrics to avoid "reinventing the wheel,"
- expecting to learn by trial and error,
- trying student peer assessment, and
- using cooperative grouping for completing assessment tasks.

Notable findings from this study about alternative assessment are described in study group member's reflections on the following topics:

- **Student achievement**—More than three fourths of the study group participants reported that student grades improved. It was commonly observed that group interactions, cooperation

on group tasks, oral and written communication performances, organizational skills, and student accountability increased.

- **Student attitude**—All of the study group participants reported improvement in student attitudes toward school work. Student involvement in classroom learning activities also increased.
- **Instructional practice**—Instruction became more integrated in nature and moved from teacher-driven to student-centered. For teachers, facilitating learning became more important than dispensing information.
- **Teacher effectiveness**—Students and their parents appreciated the variety of assessment tasks devised and used by teachers that played to student strengths and increased learning.

In addition to the sections on findings and recommendations for implementing, the reader will find 22 sample activities with scoring rubrics for elementary, middle, and high school developed and tested by study group members, a rationale for the use of performance-based or alternative assessment, a glossary of terms, criteria for quality alternative assessments, and a bibliography of related literature. *Alternative Assessments in Math and Science: Moving Toward a Moving Target* can assist readers involved in local and state efforts to implement authentic assessments of student performance and maximize instructional effectiveness for improved learning.

INTRODUCTION

Planning the Study

The restructuring of curriculum, instruction, and even schools that is currently underway in Virginia and throughout the country calls for a reexamination of assessment practices. Rather than letting assessment drive the curriculum as standardized tests have done in the past, educators are redefining curriculum in terms of what students need to know and be able to do in the "Virginia Common Core of Learning." Instructional and assessment practices are being redesigned by the Virginia Department of Education and teachers in pilot projects such as this study group to focus on student demonstration of competence and application of knowledge rather than certification of knowledge acquisition. The challenge is to create authentic assessment that mirrors real-world situations, encourages teachers to expand the scope of their instructional and assessment strategies, and motivates students to reach high levels of performance.

The Virginia Education Association (VEA) and the Appalachia Educational Laboratory (AEL) recognized this challenge and set the development of alternative forms of assessment, or performance-based assessment, in mathematics and science as the target of investigation by a study group of 22 Virginia teachers. As part of the National Education Association's (NEA) State Affiliate Consortium on Assessment and Accountability, the VEA received $23,000 in funding over two years for a proposal to involve K-12 teachers in designing and implementing alternative (performance) assessments. Technical assistance by math, assessment, and telecommunications consultants was part of the support provided by the Virginia Department of Education (VDE), along with a grant for $10,000 and videotaping assistance for the group's 1992-93 work.

Pairs of math and science teachers were invited to apply to become study group members by an invitation appearing in the October 1991 issue of the *VEA News* (Appendix A). Requirements of applicants included having: (1) the desire to write, (2) some knowledge about alternative forms of assessment or desire to learn about them, (3) a colleague in the same school who would like to work collaboratively on the project, and (4) support of school administration for released time, opportunities to share with colleagues, and plan with partners as needed to participate in the two-year project. From materials submitted by more than 40 applicants, VEA and AEL staff selected 11 pairs of teachers from ten schools in nine school districts as study group members. Teachers applied as pairs from each of the nine schools to facilitate coaching for the work of each and staff training for the home school. Schools were selected for equitable geographic and programmatic level (elementary, middle, and high) representation. The application form is included for reference in this document as Appendix B.

Conducting the Study

An alternative assessment training session began the group's work in January 1992. Members committed to develop new assessments and scoring rubrics, to implement them with their choice of

classes, and to record their reflections on this process in journals or weekly summary sheets. In subsequent meetings and while working with their partners at school, study group members designed and used assessment tasks that produced performances, presentations, portfolios, and projects. Personal communication was incorporated in feedback to students on the evaluation process.

The reporting process began in May 1992 as study group members shared collective and private written reflections, assessments and rubrics (defined in Appendix C), and samples of student work. Working as pairs on tasks they developed, members also wrote all sections of this report, peer edited, revised, rewrote, and edited the final draft.

AEL and VEA staff facilitated the study group's work by recruiting members; conducting meetings and training sessions; handling group communications and organizational tasks; disseminating relevant literature; conducting site visits; drafting selected publication sections; managing the peer editing process; melding copy from all members for the final draft; and editing, typesetting, printing, and disseminating the final document.

Additional support from VEA, AEL, NEA, and VDE during 1992-93 enabled study group members to refine their practice of using alternative assessment and to disseminate what they have learned to other teachers.

Neither the study group nor this publication advocate abandoning paper/pencil forms of student assessment and members recognize advantages of using norm-referenced tests appropriately. By retaining these traditional forms **where appropriate** and adding performance measures, assessment of all students and of each student should begin to mirror real-life performance and lead toward life-long learning. Many teachers realize that some of their students have difficulty demonstrating what they know and can do on paper/pencil tests, and that many of their students find little connection between traditional classroom tests and real-life performances. While concerned that all students develop the knowledge, skills, and attitudes essential for success during and beyond school, these educators want to play to the strengths of individual students by providing them with a variety of methods to demonstrate mastery.

This final product of the VEA-AEL Alternative Assessment study group's initial year of work is a guide to designing and implementing alternative or performance assessments and to managing their inclusion in K-12 math and science classes. The title of this document reflects the newness of alternative assessments on the educational front and the ongoing refinement of teaching processes by study group members while implementing the strategies in their classrooms.

RATIONALE

Problems with Current Assessment Practices

Grant Wiggins in *American Educator*, "Rational Numbers: Toward Grading and Scoring That Help Rather Than Harm Learning" (1988), stated:

> For most teachers, grading is a private affair. This is because teaching is a private affair, a habit that is rationalized as part of our autonomy. We have traditionally not shared our ideas and values on grading. I think this is because we fear—correctly—revealing the possible inadequacies in our own grades and the messiness and disagreements that may result if we make our criteria public...Crushing student loads and time constraints in testing and reporting schedules provide little possibility or incentive for teachers to design more authentic, labor-intensive forms of assessment (p. 22).

A review of the literature on assessment and grading indicates that a number of educators agree with Wiggins. If the grades that teachers gave were true indicators of student achievement, few educators would be clambering for change. "Current assessments are not producing answers to the questions most often asked...by parents, by concerned citizens, and by educators" (Lamar, 1987, p. 3). Have students mastered critical outcomes? Can they apply learning for success in our society? Are they prepared to be problem solvers, critical thinkers, effective communicators, and cooperative workers in the twenty-first century? Administrators and teachers in many schools are also concerned that the explosive growth of standardized testing is driving the curriculum and stealing time from instruction on critical outcomes.

Purposes of Assessment

Written tests, the most traditional example of assessment, are just one means of assessment. However, the use of paper/pencil tests currently dominates educational decisionmaking. Since 1989, every state has mandated some type of "standardized testing" (Mathematical Sciences Education Board, 1991). Such nationally normed, standardized tests provide limited information about what students know and are used primarily to compare groups of students. They tend to measure only routine procedural skills and recall of basic facts, not real-world applications of basic concepts. The exclusive use of traditional tests is one obstacle to effective educational reform. Heavy reliance on test scores has been seen as a factor in narrowing curriculum, encouraging tracking practices, and adding to failure rates; all of which lead to concerns about equity in education (FairTest & NYPIRG, 1990).

Often, students and parents consider a teacher-developed or criterion-referenced "test" as an end product of learning. Once such a test has been administered, that unit or topic is completed. The student generally does not expect to be held accountable for using the material or concepts from a tested unit at a later date. In an effort to establish links between what has been taught previously and current units of instruction, educators are pursuing

alternative modes of assessment.

Assessment is defined here as a process of collecting information for decisionmaking. It serves a variety of purposes in today's classroom. For the student, assessment aids learning and measures knowledge. For the teacher, it permits diagnosis of student learning and provides information for making instructional decisions. For the administrator and the public, it marks the effectiveness of a program and communicates overall achievement.

Many educators are shifting their teaching strategies and approaches to include more emphasis on critical thinking skills, the communication of ideas, the importance of a variety of approaches to content addressing varied student learning styles, and the need to draw explicit connections among topics for retention of learning. "Current models of learning based on cognitive psychology contend that learners gain understanding when they construct their own knowledge and develop their own cognitive maps of the interconnections among concepts and facts...to become adept at thinking and reasoning, students need practice in solving real problems" (Shepard, 1989, pp.5-6). Some educators are using pedagogical techniques, such as cooperative learning groups, to tackle real-world problem-solving and to develop the teamwork skills required by today's employers for successful employment. Real-world assessment activities refer to the performance of tasks that are valued in their own right. Assessment measures are derived from observing actual performance or relatively high-fidelity simulations of an actual performance. Some examples are open-ended problems, essays, hands-on science labs, computer simulations, and portfolio collections. In contrast, paper/pencil, multiple choice tests provide indicators of other, more discrete, valued performances. As the emphasis in instruction changes, the assessment of what has been learned must change as well.

Alternative assessment is aimed at stimulating students to think, to react to new situations, to review and revise work, to evaluate their own and others' work, and to communicate results in verbal and visual ways. Instructional practices planned for this type of assessment can improve student participation in class and allow for their input in the evaluation process. To find out how students think or to diagnose learning difficulties—the main reasons for classroom testing—teachers must provide students with choices for expressing themselves (Archbald & Newmann, 1988) and examine how skills are used in natural contexts (Gardner, 1991). Performance-based or authentic assessment consists of tasks requiring students to apply knowledge in real-world situations, given specific performance criteria within a scoring rubric for the evaluation of the performance.

In problem-solving settings outside the classroom, students need skills to decide what tools to use, what information is pertinent, how the information should be organized, what parameters restrict the solution, and which ideas should be explored and which should be discarded. After processing of information, the students must be able to communicate results to others. By using alternative modes of assessment, teachers can guide students through the development of these critical skills.

Guidelines for Authentic Assessment

In 1988 the National Council of Teachers of Mathematics led the way in curriculum reform by publishing *Curriculum and Evaluation Standards for School Mathematics*. The following aspects of evaluation from the standards (p. 199) are offered for consideration to be implemented in any classroom. While written for teachers of mathematics, they can be adapted to other curricular areas. To facilitate the reform of assessment, the emphasis in schools should be shifted from practices listed in the right hand column (see Table 1) to practices listed in the left hand column.

Table 1
Aspects of Evaluation for Effective Classroom Assessment

Increased Attention	Decreased Attention
Assessing what students know and how they think about mathematics	Assessing what students do not know
Having assessment be an integral part of teaching	Having assessment be simply counting correct answers on tests for the sole purpose of assigning grades
Focusing on a broad range of mathematical tasks and taking a holistic view of mathematics	Focusing on a large number of specific and isolated skills organized by content-behavior matrix
Developing problem situations that require the applications of a number of mathematical ideas	Using exercises or word problems requiring only one or two skills
Using multiple assessment techniques, including written, oral, and demonstration formats	Using only written tests
Using calculators, computers, and manipulatives in assessment	Excluding calculators, computers, and manipulatives from the assessment process
Evaluating the program by systematically collecting information on outcomes, curriculum, and instruction	Evaluating the program only on the basis of test scores
Using standardized achievement tests as only one of many indicators of program outcomes	Using standardized achievement tests as the only indicator of program outcomes

Kentucky teachers, in response to requirements of the Kentucky Educational Reform Act (1990), are making an important shift to more effective instruction that will align with statewide performance assessments. They, and teachers in other states who are involved in educational reform and school improvement, are moving away from the ineffective instructional practices listed in Table 2 in the right column and toward those described in the left. (Kentucky Department of Education, 1992, p. S-2)

Table 2
Aspects of Instruction for Educational Reform and Performance Assessment

To Instruction That:	Away From Instruction That:
Sees students as active creators of meaning and learning	Views students as passive recipients of knowledge and skill
Involves high expectations for ALL	Involves high expectations for SOME
Is focused on critical outcomes	Based upon an assortment of objectives
Encourages students to become proficient at using reading, writing, mathematics, and the other basic skills in all areas of the curriculum	Views basic communication and math skills as the sole responsibility of the language arts, English, or mathematics teacher
Is focused on the ability to apply what has been learned to real-life problems	Is focused on recall of facts and rote learning
Encourages student inquiry and exploration	Relies on the teacher as the sole source of all answers
Involves students in hands-on investigations and interpretive discussions	Limits students to reading textbooks and answering low-level questions
Groups students flexibly based on interests, work habits, learning needs, or the nature of the task	Groups students based on skill ability
Is focused on concepts, important skills in authentic contexts, processes and attitudes	Is focused on isolated skills in a rigid sequence
Integrates or correlates content areas when appropriate	Is focused on narrow content area
Involves students in collaborative learning	Isolates students or places them in competition with one another

In the classroom, the assessment modes selected should reflect the outcome goals for students of that class. A range of activities (e.g., experiments to be conducted, types of problems to be solved, reports to be presented) can be determined in advance and assessment tasks and standards can then be created for the critical objectives of the goal (Baker & Herman, 1983). Assessment becomes part of the instructional process, and visa versa, as planning evolves based on student progress toward goals, thus increasing the validity of such measures. Assessment should be an integral part of curriculum and instruction representing a recursive, lifelong process that provides meaningful information to teachers and students about teaching and learning.

Implementing an alternative assessment program requires substantial teacher training. However, the positive impact on curriculum and instruction is worth the investment as teachers use varied assessment approaches to improve instruction. School faculties who have completed intensive training report improved morale and increased incentive to take instructional risks. Creative solutions to the cost of staff development and the time required to administer alternative assessments in the classroom are needed. Grant writing, flexible scheduling, professional scoring services, and remote computer scoring may address these needs (Aschbacher, 1991, p.4). Before implementation begins misconceptions should be addressed so that all participants may benefit from the use of alternative forms of assessment.

Myths About Alternative Assessment

Several myths about alternative assessment exist. A discussion of findings of related literature may be helpful in dispelling fears and hesitation to try more authentic assessment activities.

Alternative assessment short-changes the above average student. The term **standard** is often equated with focused attention to excellence and quality. A classroom or school has high standards when it has realistic, rigorous, clear, and consistent expectations of all learners. High standards are demonstrated by student attention to self-discipline, dedication, responsibility, and craftsmanship, and alternative assessments set the specific standards and measures for judging the quality of a student performance. When high standards are in place, concrete benchmarks are established for evaluating student work at essential tasks and holding students accountable for meeting and even exceeding the target. Higher order processes are emphasized, including evaluation and synthesis, and expected of all students. Assessment standards are met by rigorous evaluation of necessarily varied student products and performances against those standards (Wiggins, 1991).

Alternative assessment tasks may be conducted within the context of cooperative groups. Students of mixed ability levels work toward a common learning goal and share the responsibility for mastery of the objective by everyone in the group. One highly effective method of learning is to teach others. The advanced student can take the role of peer tutor in this instance, broadening and improving his/her own understanding of a concept in the process.

Alternative assessment consists of nothing more than "touchy, feely" activities. Assessment in general may be used for several purposes: a) diagnosing needs of individual students, b) diagnosing group needs, c) assigning grades, d) identifying students for special services, e) controlling or motivating student behaviors, f) evaluating instruction, g) communicating achievement expectations, and h) as a teaching strategy (Stiggins & Conklin, 1992). In order to fulfill these purposes, assessments should involve students in realistic activities where skills are applied to situations that illustrate the ability to understand and use those skills. The direct assessment of complex performances in alternative assessment does just that (Linn, Baker, Dunbar, 1991). Teachers are able to observe the application of skills in new situations as a means of diagnosing student needs, evaluating progress, assigning grades, and evaluating the need to adjust instruction. Achievement expectations are communicated through the rubrics and benchmarks stated for alternative assessment tasks. The tasks themselves become teaching and learning opportunities when students peer evaluate, as is often done in alternative assessments.

Alternative assessments require hands-on, concrete applications of learning in many instances. Learning theory has always advocated the use of manipulatives and hands-on applications for students as effective methods for addressing all learning styles while ensuring equity of opportunity for learning as well as the retention of learning. However, also included in alternative assessment tasks are open-ended problems requiring higher level thinking, essays, computer simulations, and portfolios or collections of student work over time. These activities as well as hands-on problems are called authentic measures of learning because they consist of the performance of tasks that are valued in their own right (Linn, Baker, Dunbar, 1991).

Alternative assessment does not provide clearly defined performance standards, so all students get A's. "When used in the singular to describe human accomplishment, a standard is an exemplary performance serving as a benchmark" (Wiggins, 1991). Alternative assessment standards provide models and criteria against which students can measure their own learning. Even though the observation of student performance by a teacher may be overly subjective, the use of clear rubrics with distinct criteria and student prior knowledge of benchmarks reduces this risk. Performance competition in sports has always used specific scoring criteria accepted worldwide as witnessed at any Olympics where judges find a very high level of agreement (Maeroff, 1991).

One approach to standardizing performance

Table 3
Kentucky Statewide Assessment Program Performance Levels

Performance Level	Definition
Distinguished	The student completes all important components of the task and communicates ideas clearly. The student demonstrates in-depth understanding of the relevant concepts and/or process. Where appropriate, the student offers insightful interpretations or extensions (generalizations, applications, and analogies).
Proficient	The student completes most important components of the task and communicates clearly. The student demonstrates understanding of major concepts even though she/he overlooks or some less important ideas or details.
Apprentice	The student completes some important components of the task and communicates those clearly. The student demonstrates that there are gaps in his/her conceptual understanding.
Novice	The student shows minimal understanding. The student is unable to generate strategy; answers may display only recall effect, lack clear communication and/or be totally incorrect or irrelevant (Winograd, 1992).

levels and emphasizing the developmental nature of learning is shown in the Kentucky performance level definitions for alternative assessment (Winograd, 1992). Certainly, not every student will initially perform at the "distinguished" level. However, the desired outcome is that all students perform to their maximum level of ability and ultimately master appropriate knowledge and skills. This becomes possible when the student has a clearly defined target at which to aim and for which to strive. The search for higher standards begins with identifying those that deal with what students should know and be able to do.

The teacher cannot cover everything else and do alternative assessment, too. Some forms of alternative assessment are time consuming. Performance-based tasks may not lend themselves to time-efficient scoring. However, they do test what the educational system is supposedly responsible for teaching, the prerequisites for performing well in life (Bowers, 1989).

The debate continues over whether students benefit more from "covering" material or from "learning" concepts and skills in depth for life-long learning. Should we teach everything briefly, or concentrate on a manageable number of critical concepts? Most school districts have already begun the process of refocusing the ever-expanding curriculum toward essential learning outcomes. Is alternative assessment worth the time and effort required? Proponents believe so.

Low cost and speed of scoring allowed norm-referenced testing to rule education for a long time. Alternative assessment tends to be labor-intensive and time consuming, but advocates of alternative assessment are intent on creating an assessment system imbedded in instruction and based on desired outcomes. An approach that shows student

progress over time, a grade period-long videotape versus a single snapshot of student work best serves that purpose (Maeroff, 1991).

Time is a valuable commodity in the classroom and its use may be conserved by employing collaborative group activities and peer assessments in which students become more responsible for certain aspects of their own evaluation. It is possible to evaluate a variety of processing skills and student growth through interaction with other students, as well as with the teacher. As students are allowed to make choices and defend those choices, participation and enthusiasm in classroom discussions and activities increase.

Many educators are creating time for the construction of alternative assessments and the evaluation of student performance by reorganizing the school schedule and by using team teaching. Through grant writing and other funding sources, schools are financing additional staffing, use of substitute teachers, professional scoring services, and remote computer scoring. Alternative assessments can be implemented gradually and integrated with more traditional forms of classroom assessment as suggested in the Implementation section of this document. The benefits seem to outweigh the costs. In this project, study group members also recognized the enormous benefit to teachers in professional growth gained from designing, administering, and scoring alternative assessments.

In summary, alternative assessment can involve students in their own learning, stimulate critical thought and input, improve attitude, and increase interest. Alternative assessment can be easily incorporated into cooperative learning activities that are designed to improve students' communication and social skills. If the goals of education include developing higher level thinking and reasoning skills and creative problem-solving, then assessments should seek to evaluate those processes. The findings from this study reported on the following pages show examples, results, and reactions to alternative assessment activities developed and tested by members of the study group.

FINDINGS OF THE STUDY

This section of *Alternative Assessments in Math and Science: Moving Toward a Moving Target* explores lessons learned in phase one as participating teacher teams reflected on the first year's experiences in their schools. Perceptions of self, partner, peer teachers, principal, and students are described in five subsections: Student Achievement, Student Attitude, Instructional Practice, Working Conditions, and Teacher Effectiveness.

Reflections of the 22 study group members and summaries of major points are explained and supported with stories, quotes, specific examples, and details of classroom experiences. Analysis of weekly logs charting problems and successes, and written reflections to specific questions regarding the implementation of alternative assessments furnished information for this section.

Nearing the end of the project's first year, study group members individually wrote responses to several clarifying questions concerning their perceptions of student achievement and attitude. Then, in reflecting on working conditions, the 22 teachers discussed and wrote about the time factor involved, time-savers developed, administrative support, and the availability of necessary resources. Major points concerning instructional practice centered on how teaching methods changed as alternative assessments were implemented. Teachers analyzed the feedback received on their effectiveness with alternative assessments from students, partners, peers, and principals as they described their own effectiveness.

In developing this section on findings, pairs of study group members analyzed and reported on commonalities found among the responses of their colleagues to each set of questions for the five subsections. Qualitative assessment instruments and weekly summary sheets are included as Appendices E, F, and G of this document. The discussions and reflections in this section provide valuable insights into the actual workings of and interactions produced by more authentic methods of assessing what children know.

Student Achievement

Within this study group on alternative assessment, teachers were asked to answer three questions: "What do I see?," "What can students do?," and "What do students tell me about alternative assessments?" This subsection summarizes their responses in regard to achievement, as well as describing some examples of student work. Additionally, one investigation is discussed that addressed the issue of depth of learning. In this substudy, science students at a high school were assigned to two groups. The test group used alternative assessment activities in addition to traditional tests as part of instructional strategies dealing with a study of plant anatomy. The control group studied the same concept in a more traditional way, which included lecture, films, reading, laboratory activities, field observations, and paper/pencil tests. On a test selected from the publishers' test bank, ostensibly a validated multiple choice test, there was no significant difference between the experimental and control groups' mean performances.

However, a number of study group member observations suggest that further study is needed.

For example, 16 of 22 study group participants reported that "grades improved" when students were using alternative assessment activities in class. It is possible that, as one teacher commented, "Success breeds success." The alternative assessment activities appeared to promote success and higher achievement. This was reflected in performance observed across student ability levels. As one participant noted: "Across the whole range of levels—gifted, average, remedial—I saw improvement. This occurred because I was asking them to **do what they had learned**, not just memorize facts and bits of information they could not tie together." It may be that the improvement of performance and achievement is correlated with the use of alternative assessment. This study group also recognized the possibility of a "Hawthorne effect" resulting from teacher expectations and is conducting further studies to investigate the possibility.

It was commonly observed that group interactions, cooperation on group tasks, oral and written communication performances, organizational skills, and student accountability improved. This occurred most often on alternative assessments which required group work, such as group design of scoring rubrics, reports, laboratory implementations, and mathematical problem-solving. Student self-assessment was commonly incorporated into the assessments; thus, students became more observant of their own progress and interactions. It was observed that they were "communicating with their teachers and peers to explain their work, the choices they made, and how they made their decisions."

Overall, students achieved at high levels of performance according to the rubrics that were designed and distributed as part of the assessments. They appreciated the variety of opportunities, to demonstrate their successes.

Alternative assessment tasks that students completed as part of this study group investigation included the following types of activities and products:

Portfolios—Self selected content

Presentations—In class
To other classes
To community groups

Artwork—Integral to other types of assessment
As a stand alone alternative

Reports—Non-traditional products
Poems and poetic analysis
Short stories

Video reports and interviews

Models—Two and three dimensional

Research projects—For exhibition

Timelines—Integrating disciplines

Computerized telecommunications projects

Games

Student designed test—For other students
For the teacher

Laboratory design projects

Perhaps student successes and subsequent achievement are most clearly demonstrated by these two observations: "The kids started asking if they would get to evaluate groups again," reported one middle school teacher, "They were eager to try future group alternative assessments in an industrial arts exploratory class." Another teacher observed that instead of hearing, "Oh no, a test!" students began to say, "Oh boy, we get to do this for a grade!" The evidence presented later in this section demonstrates a range of products which students completed, working on a variety of levels. Their productivity and subsequent achievement grew with the use of alternative assessment tasks.

Samples and discussions of student works are included here as a means of illustrating the types of activities in this alternative assessment program and as models of student achievement. For portfolio assessment, students in physical science collected demonstration materials that they felt illustrated their progress in the course. Some of the items were teacher selected and others were selected by students. The Table of Contents for the physical science demonstration file (portfolio) is shown in Table 4 on page 13 with a sample of student inclusions (italics).

Table 4
Table of Contents For Science 8 Demonstration File

Biography: Scientist (1)		*Marie Curie*
Article Review (2)		
Best Lab Report (3)		*Changes w/Solutions & Mix* *Flame Tests* *Displacement Reactions*
Favorite Lab Report (3)		*Making Molecules* *Pitch* *Volume of a Baseball*
Interview (1)		
Self-Assessment (2)		*CaCl2 and Temperature*
Peer Assessment (2)		*CaCl2 and Temperature*
Photographs:	Project Topic (1)	
	Creative (1)	
Poems:	Self (3)	*Haikus* *Magnets* *Sonnets*
	Others (3) (with analysis)	*Crime on Mars* *Sonnet to Science*
Science Lab Demonstration (1)		*Using Electricity to Change Acids/Neutrals Into*
Class Evaluation (2)		
Book Report (1)		

Personal selections: Choose five things of your own that can demonstrate what you have learned in science during this course.

Greenhouse Effect paper taught me about environmental issues.
Scientist Identifications taught me about men and women's contributions.
Magnesium report - I learned about an element and its uses.
Biomass report - I learned of an alternative, more environmentally safe type of energy.

Students were also interviewed concerning their selections by members of the team. In the beginning, these interviews were videotaped. However, due to time constraints and equipment acquisition difficulties, the videotaping was dropped from the evaluation of student portfolios. Teachers will keep the portfolios to monitor longitudinal student progress in the next three years. Teachers and students questioned felt that the first year's results were positive.

In another project, students who were studying acids and bases prepared a public presentation for another class which demonstrated their understanding. The rubric for determining success on the

presentation was designed to include evaluations of not only the scientific content of the presentation, but also of the preliminary Virginia Common Core of Learning Skills and of scientific communication skills in the presentation (see Table 5). With the aid of criteria from the English department, public speaking skills were also evaluated. Presentations were videotaped and analyzed with students taking part in the evaluation. On the whole, knowledge of scientific concepts as well as communication skills improved with the active involvement of students in alternative assessment tasks. In measurement activities students were involved in hands-on tasks that required cooperative work with a small group of students. They helped each other to reach the goal of the activity and were responsible for each other's learning. "Excitement grew as they manipulated measurement devices to apply skills in realistic situations." Errors could be corrected and accuracy increased as students worked together—peer or self-assessing for progress against the rubric. "Students learned to solve problems without continual teacher input as they became more responsible for their own learning," read one teacher journal entry.

Table 5
Evaluation Rubric for Sixth-Grade Presentation on Acids, Bases, and Salts

Note: SOL = Virginia Standards of Learning
Rel. = Relationships between disciplines

Ratings: 1 = very weak 2 = weak 3 = average 4 = strong 5 = very strong

A. Standards of Learning (SOL) Program Goals:

Goals	Objectives	Curriculum Guidelines		
II	A	Skill	2 classification	( )
			3 communication	( )
			6 predictions	( )
II	B	Theme	1 change	( )
			3 interrelationship	( )
			6 variations	( )
IV	A	Rel.	3 communication	( )

Program Goal II: The science program should be consistent with the nature of science which includes its philosophy, methods of investigation and verification, conceptual organization, and accumulated knowledge.

Objective A: The science program should emphasize process skills beginning with basic processes at the elementary level and continuing with the integrated skills at higher grade levels.

Objective B: The science program should develop the overall conceptual themes of science.

Program Goal IV: The science program should relate to other curricula areas.

Objective A: Appropriate concepts, processes, values, and skills of other disciplines should be integrated into science.

Table 5 (continued)

B. SOL Content specific objectives for middle and high school levels:

6.1	Acids and bases	( )
6.2	Process skills	( )
6.5	Compound Classification	( )
6.6	Chemical properties	( )
7.1	Process skills	( )
8.1	Process skills	( )
8.5	Chemical properties	( )
8.7	Practical uses	( )
11.1	Equipment handling	( )
11.2	Lab design and experiment.	( )
11.3	Acids, bases, and salts	( )

C. Virginia Common Core of Learning Skills, Working Paper Guidelines and Goals:

Personal Resources		
p. 9	Determining what is needed to meet a goal	( )
	Securing the resources to meet a goal	( )
	Planning in order to avoid waste of time	( )
Communication		
p. 10	Controlling level of formality for audience	( )
	Understanding ideas and talking about them	( )
	Judging the needs of the audience	( )
	Organizing what to say	( )
Thought		
p. 12	Defining appropriate goals	( )
	Developing a workable plan	( )
	Getting appropriate information	( )
	Sequencing information appropriately	( )

D. Narrative Comments

A number of interdisciplinary assessment activities was also used by study group members and their students. In an art/science integration activity the students were to use artistic expression to communicate about the biology of an organism. Writing and illustrating skills came into play for this science task. For a literature/science integration, students used literature skills to communicate information about scientific phenomena in poetic form, and then pulled from their scientific backgrounds to analyze literature selections related to the topic of study. One student's interpretation of Edgar Allen Poe's poem, "Sonnet: To Science," is shown in Table 6 on page 16 with the evaluation rubric. Recognizing that publication is an essential part of scientific communication and that objective peer review is important, student creative works were submitted to the school literary magazine for evaluation by its editor.

Song to Science

We are born into darkness
Our minds void of light
Science can guide us
With its light ray, so bright.

But, Science strips away romance
And blinds us witn truth
Imaginations cease to dance
Imaginations stilled by truth.

Vanish? Be gone from here
Stop your attacks on me
I can't stand to live in fear
I want my soul to be free.

Science, what a thief thou art
A predator feasting upon my heart.

by Erin Rebecca Bull

Table 6

Evaluation Rubric for Student Work on Science/ Literature Integration Project

In producing a poetic interpretation of scientific observations or conclusions, the following minimum standards were set:

1. The student should read and be able to discuss the models in class.
2. During the discussion, the student should actively participate.
3. The student should be able to effectively communicate his/her personal interpretation of the work.
4. In production of the student poem the student should:
   a. Use proper rhyme scheme
   b. Use correct metrical style
   c. Use appropriate figurative language
   d. Incorporate correct scientific information
5. For full credit the work must be submitted to an outside evaluator such as the editor of the school literary magazine or other publication of choice.

Excellent—level of work includes all of the above.

Acceptable—level of work is lacking in or weak in only one of the areas described above.

Unacceptable—level of work lacks or is weak in more than one of the above criteria.

In a similar communication skills project at another school, students kept a journal of their observations of plant growth and were encouraged to illustrate their writing in the journals.

Incorporating communication skills and use of the creative arts into content area assessment tasks helped students make connections between their learning and applications of life-long skills for success in other endeavors. One enthusiastic teacher said, "I saw achievement from students who in the past could not pass a single pencil/paper type test in my class. Now that is progress. Some grades have improved because the assessments have been varied and in most cases more exciting and interesting to students." Another teacher commenting on student achievement claimed, "Students doing the alternative activities demonstrated a thinking process not apparent in traditional tests. Problem-solving and questioning techniques, use of previous knowledge and creativity could be demonstrated in one assessment." In another study group member's class, students commented frequently that their level of achievement had improved as demonstrated by higher grades. "Some students spent more time and did more than the activity required when given new and different types of assessment tasks. They now realize that there may be more than one way to answer a question and they use different approaches to solve problems." In this study more students were able to show success with a wider variety of avenues from which to choose for their performance in the assessment activities described here.

In order to assess student performance effectively, teachers and students developed rubrics that described the standards for achievement and included level of performance descriptions, or benchmarks. An example of a device that was used to assess artistic performance from a scientific perspective is shown in Table 7. A student-developed rubric for assessing success in a project for the study of polygons is shown in Table 8.

Table 7
Evaluation Rubric for an Art/Science Activity

1. Work should include representations from each of the kingdoms studied.
2. Specimens should be presented at time of submission.
3. Work should be in at least three different media, one of which must be pen and ink.
4. At least one three-dimensional representation should be included.
5. Work, except for the three-dimensional one, should be mounted and matted.
6. In print, accompanying each work and specimen, collection data should be included containing the following:
   - Collection date
   - Art completion date
   - Collection location
   - One "neat fact" about the specimen
7. Work should be proportionally correct (to scale).
8. Different perspectives should be included (ventral/dorsal).
9. Close up detail of important structures should be included.
10. Scale of evaluation: (Benchmarks)

All of the above criteria met	Excellent
Artistic merit notable, but scientific content lacking	Fair
Poor artistic quality and low scientific content	Poor

Table 8
Polygon Rubric Written by Ninth Grade Resource Math Students

After constructing seven polygons that had been studied with Cuisinere rods, students wrote the following rubric that a judging team could use to assess each student's constructions and the accompanying student explanations.

1. All seven polygons are represented.	7 = good; 5,6 = acceptable; 4 or less = not acceptable
2. Student can correctly identify each of the polygons.	7 = good; 5,6 = acceptable; 4 or less = not acceptable
3. Student can correctly describe sides using terms parallel and perpendicular.	7 = good; 5,6 = acceptable; 4 or less = not acceptable
4. Student constructed angles correctly and communicates the correct descriptions of the angles for each polygon using correct terms (right angle, obtuse angle, acute angle).	7 = good; 5,6 = acceptable; 4 or less = not acceptable

As one teacher reflected, students "could do anything if given clear criteria, examples, and the freedom to develop their own products" within the boundaries of the objectives and rubrics. There appeared to be few limits to how much an ambitious student could achieve, if the standards and levels of performance required were clearly defined and understood. Uncertainty and confusion about objectives and goals for performance were two road blocks removed by alternative assessment tasks.

Student Attitude

Today's educators work with students who often exhibit apathetic or negative attitudes toward learning. Poor attitudes may be attributed to problems students face outside the school environment such as drug abuse, troubled home life, and peer pressure. Educators are searching for new methods to change negative student feelings and actions toward school. This subsection describes how implementing alternative assessment improved student attitudes for this study group. Study group members individually responded in writing to questions such as: "What do I see? What can students do?" "What do students tell me in regard to their attitudes about alternative assessments?"

Analysis of responses revealed that study group members had observed negative attitudes when traditional methods of assessment such as paper/pencil and norm-referenced tests were used. One middle school teacher stated that her students did not consider a traditional paper/pencil test as being something from which to learn; instead, this type of test was perceived as something that was "done to" students. However, when study group members used alternative assessments with product and performance tasks, students expressed excitement and enthusiasm. Some comments that study group members heard from students were: "I like this," "When can we do this again," and "I feel good. For the first time, I did something right and got it in on time. This is fun. It's easy. I like it because I finished my work and it (the assessment) helped me keep up with the work for the portfolio." Many students were pleased that test grades could be earned by doing "something fun."

A high school special education teacher noticed a positive change in one student for whom a project was especially meaningful. This special education student had always been very shy, retiring, and had displayed characteristics of low self-esteem. Her grades were very poor even though she worked diligently. However, once alternative assessment activities were implemented, she began to experience success. With one particular biology project in scientific methodology, she went beyond what was required for the project. On her own, she interviewed an optometrist about contact lenses and did extra reading to formulate questions for the personal interview. The student seemed to become more confident as she worked on a research project that was related to her own visual handicap. An alternative assessment of her understanding of the anatomy of the human eye and the optical nerve was designed using the form in Table 9 on page 19 instead of a traditional paper/pencil test.

The student's success on the research project was evaluated using a modification of guidelines by Giese, et al, (1989), as shown in Table 10 on page 20 and Table 11 on page 21.

"I feel so positive when I see her holding her head up, smiling and going after what she wants," stated her teacher, "Pretty impressive for a girl who tried everything to fade into the woodwork at the beginning of the year."

Judged by the frequency of positive observations by the participants (all reported some form of improvement in student attitude) and the enthusiasm displayed during the study, the utilization of alternative assessments improved student attitudes toward their work. Teachers have reported that, "Students appreciated the opportunity to do alternative assessments." One teacher even reported that students came to him and asked if they could do alternative assessments such as art work, short stories, cartoons, or games, which they had designed themselves, on a biology assignment. In one advanced chemistry class, students who were normally reluctant to participate in group research projects entered into a "flurry of activity," once they could see exactly what was expected of them in the teacher-developed rubric. In another instance,

Table 9
Alternative Assessment Design Sheet for a Science Project for the Visually Impaired Student

I. Prior knowledge or experience required
   A. Scientific reporting
   B. Contact lenses
   C. Eye functioning

II. Concept or objective
   A. The scientific method an library research skills
   B. SOL 10.2 and 10.3

III. Tools and materials
   A. Lenses, ray box, light source
   B. Opticians or optometrist
   C. Literature/interview

IV. Motivation
   A. Academic fair entry
   B. Literature/Science combination
   C. Personal experience

V. Learning activities
   A. Select types
   B. Identify variables
   C. Select independent variables and dependent variables
   D. Conduct an experiment
   E. Report findings

VI. Assessment
   A. Prepare a paper using the Standard High School Science Report Technique on the research done.
   B. Display work in Academic Fair exhibition

VII. Rubric—See Tables 10 & 11, pp. 20-21.

a quiet, reserved student, who seemed to speak out only reluctantly even though she earned mainly A's on traditional tests, blossomed into a highly communicative and creative student when given an opportunity to perform on alternative assessments. Other students "...gleefully worked on their alternative assessment tasks with noticeable enthusiasm and creativity."

A teacher of junior high school students commented, "I see kids saying thank you, sending notes to my aide and me, smiling, asking to do things with less stress and fewer 'I-don't-care attitudes'. Students feel successful. They are anxious to try rather than give up." Students who performed poorly before alternative assessments became more enthusiastic about doing quality work. "They feel they have a bigger part in determining their own grades with alternative assessments" wrote one teacher in her daily reflections. "They put in the extra time to do more extensive projects. Some shared their work with other teachers and students."

Not all students eagerly embraced alternative assessment. A few, often students who were very successful on traditional paper and pencil multiple choice tests, were reluctant to take on the challenge of the more in-depth assessment instruments which were developed for classroom use. In some instances, students with poor organizational skills who lacked practice in long-term project development appeared to have difficulty with alternative assessments, and were reluctant to try more than one. In one instance, when an alternative writing assignment was used in a mathematics class, some students "chose to take the zero" rather than do the assignment. They felt that "writing was not part of math." However, on other alternative assessments, once many of these reluctant students "got going," they not only completed the tasks, but excelled in a number of them.

Study group members also noted a change in student involvement. With alternative assessment, students took pride in their work and were willing to put in the extra effort required. "They showed excitement as they talked among themselves and helped each other in performing alternative assessment tasks," said an elementary teacher. Another teacher responded, "I see more students staying after school, asking more questions, and becoming

Table 10
Criteria for Assessing the Academic Fair Project

Criterion, (Point Value), Description, Score

Title (10): Should be as short as possible but be informative, descriptive, and interesting. _____

Hypothesis (10): Should be clearly stated in a testable way, alternative hypothesis should also be stated. Each should include the level of testing or the statistic used. _____

Independent variable (10): The tested independent variable should be clearly identified in terms of an operational definition. _____

Levels of independent variable (10): All of the tested levels of the independent variable should be identified. _____

Control (10): The control with which the experimental groups are compared should be properly identified. Other constant variables must be considered. _____

Repeated trials (10): An appropriate number of repetitions of the experimental conditions should be observed and the proper statistic for describing the data should be used. _____

Dependent variables (10): The dependent variable should be identified and properly operationally defined. _____

Measures of dependent variables (10): These should be recorded in an appropriate data table, properly labelled, and include appropriate statistics. _____

Experimental design diagram or photograph (10): This must clearly show the setup that was done and the relationships between the materials well enough to be followed by an independent experimenter who would want to repeat the work. _____

Appropriate level of complexity (10): This must be at the instructional level of the students. Tenth graders should not be doing a seventh grade level project. _____

Creativity (10): This is reflected in using a new project or doing an old one from a new and different perspective so that it is obviously unique. _____

Adapted from Giese, et.al. (1989)

more involved during class." As involvement increased, students began to take ownership of their learning. When students participated in the evaluation process, they became more responsible for their work. For example, a fourth grade teacher described a student who previously did only enough work to "get by." He had a very care-free attitude about school and appeared to enjoy showing off. After she implemented alternative assessment, he became involved in his own learning, became

Table 11
Report Specifics

In the report, the student should include all of the following in addition to the above mentioned items.

Background (20): Include a thorough discussion of the topic and include the reason for studying the topic. It should include material from several sources, including a brief discussion of other studies. _____

Materials (10): A complete listing of relevant specialized materials used in the research. Do not include common items that are not specialized for the research such as paper, pencil, books, etc. _____

Procedure (20): Should be complete enough for someone else to read and repeat what was done in the research. _____

Data (10): In the proper table(s). _____

Conclusion/analysis (20): Must include a statement about the acceptance or rejection of the hypothesis and be based upon the data. The analysis section should reflect how the conclusions relate to the background and include possible explanations for the results. _____

General visual presentation effect (20): The use of proper materials in making the display attractive and clearly demonstrating the findings in the presentation. _____

Adapted from Giese, et.al. (1989)

knowledgeable, and began to enjoy school without acting out. This student eventually made the honor roll and other teachers noticed more on-task behavior.

Overall, study group members observed positive attitudes with the use of alternative assessments, yet some members detected negative opinions from some students. A few students displayed frustration when asked to be creative. Students who usually did well on traditional tests did not want to risk trying something new. These children often stated, "Just give me the test." The same students seemed to still buy into the "What-grade-did-I-get?" syndrome, in order to compare grades and compete with others.

However, for most students in study group member classes, using alternative assessments improved student attitudes and increased self-esteem. The alternative assessment projects allowed students to take an active role and to develop pride in their learning as they put it into practice. All members of the study group reported students becoming excited about alternative assessments and more interested in learning. Students were proud of their accomplishments and developed a strong sense of ownership for their products, even exhibiting a mild panic when a portfolio was temporarily misplaced. Students were observed to be more involved in their work, especially those who had not been successful on traditional tests. On the whole, student attitudes toward learning showed improvement as a result of the alternative assessments used in their classrooms. They enjoyed the variety of the alternative assessment activities and the sense of fulfillment or accomplishment acquired from "hitting the target."

Instructional Practice

Instructional practice encompasses the techniques and methods the teacher uses to facilitate learning within the prescribed curriculum. These practices range from traditional teacher-centered lectures to student-directed programs. Study group members were asked two questions in regard to their instructional practices during the implementation phase: "How have your teaching methods changed as you have implemented alternative assessment?" and "What are you doing differently?"

In examining the responses to these questions, it was determined that a majority of the participants agreed on several points. For elementary teachers in particular, no major changes in instructional practices were reported. However, these teachers described becoming more aware of their customary practices and improved in planning and writing rubrics. Teachers began to match their assessment to their instruction rather than allowing the assessment to drive the instruction. Recent related literature suggests that assessments should match not only the objectives for learner outcomes, but the instructional strategies used to teach toward mastery of those objectives as well. Only that which is taught should be tested in a manner consistent with how that concept is taught.

A respondent commented, "As I implemented alternative assessments I saw a decrease in grading stacks of papers each night. Students evaluated their own work along with the teacher and had immediate feedback about strengths and/or weaknesses. Students were allowed to set deadlines for their own mastery and I guided their learning rather than telling them facts they should know. Students were asked for input and helped with the initial planning of assessments. I incorporated more videotaping, photographing, and audio-cassette taping of student performances." Another instructor said, "I am now thinking more about the criteria for successful completion of any demonstration of mastery. I am trying to more clearly let students know what a successful performance or product will be."

Study group members also noted that their instruction became more integrated in nature, with the use of thematic units to incorporate various subject areas and learning strategies. All reported using more hands-on units, a variety of activities, and more open-ended labs and questions to stimulate student involvement and accommodate learning styles. "I look for different ways to assess student achievement, not just pencil/paper tests and grades. There is more variety in my instructional practices and more student facilitated instruction. I involve students in the development of the assessment and in assessing themselves and their peers," wrote one teacher. "We are not talking as much, but letting students assume the responsibility for learning by talking about what they know. We are lessening teacher control resulting in higher noise levels and 'organized confusion' as it may appear to the untrained." "I have tried to provide more hands-on activities that actively engage the students in the use of higher order thinking strategies instead of expecting them to regurgitate facts."

Teachers and students moved away from the exclusive use of adopted textbooks and toward outside resources and trade books. A variety of materials were reported as being used to facilitate learning with more extensive and in-depth projects being assigned. Research on a long-term basis appealed to students on topics of interest to them. One teacher reported that, "We have more open-ended discussions and have moved away from time concerns. I have allowed time for students to do the work necessary to learn rather than just covering the material."

Instruction was described as becoming more student-oriented rather than teacher-driven. Students became more responsible for their own learning. They learned to self-assess, a valuable life-long skill. "I have put more responsibility for learning on my students and have taught them how to use various sources of information. Teaching has included more discovery lessons for students and the use of technology. Assessment uses the same resources." Another teacher summed up instructional practice changes by saying, "I lecture less and advise more. It is difficult, but I am trying to let the students take over more of the class by practicing what they have learned and evaluating their own

work against the standards." Members of this study group reported becoming facilitators of knowledge—"guides on the side, not sages on the stage."

After implementing alternative assessment, and changing some of their teaching methods, teachers had clear ideas about their instructional practices and the teacher's role in the classroom. "Students see me as a helper, a facilitator, a counselor, and a leader who will guide them through the learning process rather than force them through," said one. Others agreed that they became more aware of new practices and more enthused about education. They advised other teachers, "Don't try to fit the new to the old. Cut ties to past ways of assessing."

Student comments after developing an alternative assessment for their high school biology instructor illustrated an appreciation for test making. "I think the best test is one where you test someone else." "I'm really going to get you on this one." "This is hard to do." After all of the work done by students, it took the teacher over five hours to respond to the student-made tests. When a chemistry teacher assigned an experiment as an alternative assessment with the necessary equipment furnished and **no instructions**, students wanted to know, "How do we do it?" and "What do we do?" The teacher's journal comment at the close of the activity described the end result. "Through collaboration and creative thinking the students did figure out how to perform the experiment which built a great deal of confidence for them."

In conclusion, math and science teachers who have participated in this project over several months described becoming much more aware of their own instructional practices and looking forward to additional work in the field of alternative assessment, especially in refining rubrics.

Working Conditions

Conditions of the teaching environment that enhanced or hindered teacher effectiveness and student performance while using alternative assessment in the study group project were examined. Study group members were asked, "In your school setting, what has helped or hindered your project in relation to the conditions essential for successful implementation: 1) time for learning, sharing, and peer (teacher) assistance; 2) administrative support; and 3) resources for supplies, materials, or equipment?"

Study group members concurred that time is a major factor in student progress toward mastery of objectives. Teachers must plan time for students to work independently, with peers, with the teacher, for learning, for practice, and for evaluation of learning. Individual assessment of student performance required additional time. One study group member wrote that, "There is less time for me to lecture because the students are interacting and quizzing each other. Maybe that is not bad!" Another response indicated that, "It takes a lot of time to work the problems that students make up for the teacher, but it is worth it when I see them checking my answers far more carefully than they would their own work." Students must also make wise use of time in the classroom to benefit from instruction and assessment activities. The group process skills of peer evaluation and cooperative learning are helpful for maximizing use of available time.

Seldom is sufficient time available to teachers for their own or peer sharing and planning, so many arrive at school early, stay late, or do planning at home after school hours. Flexible scheduling and team teaching provided additional planning time for some members of this project. Study group members also needed an abundance of reading and thinking time to process new information about alternative assessments and to produce meaningful activities and rubrics. Time management for teachers and students is a vital key to successful implementation of alternative assessments, and the school administrator plays a vital role in assisting that effort.

On the whole, administrative support in study group members' schools was excellent. Reflections and comments from teachers indicated that principals provided funding and classroom coverage for attending project meetings as school budgets allowed. One typical description of administrative support reported that, "My principal visits and enjoys seeing active learning and student work displayed. Alternative assessment is supported be-

cause results correlate directly with pupils' achievement in relation to objectives." "My principal supports innovative instruction and assessment," reflected another teacher. "The administration is supportive in spirit, but funding is limited as far as additional hands-on materials." It was also suggested that the alternative assessment activities and the learning that resulted made the administrator "look good" and resulted in positive support. Some principals approved additional activities for the classes involved in this study beyond original requirements, arranged for common planning periods, granted professional leave, and provided substitute teachers from school funds. It was noted that principals must agree with the philosophy that all students can learn and perform tasks which demonstrate their learning. Teachers also need support as they help parents understand new methods of assessment. Teachers commented that they do not want to feel that they are "out on a limb by themselves" as they work to improve learning opportunities and assure positive results for their students.

Generally, school district support was perceived as lacking acknowledgement for the work of this group and characterized by some skepticism about the benefit of alternative assessments. However, one study group member felt that the district's central office had been very supportive. Additional awareness activities may improve support from local school district administration.

The availability or allocation of resources varied widely among the 22 participants in this study. Teachers reported that it was necessary to plan assessment around the materials and resources available rather than planning their materials and resources based on the assessment. As one teacher noted, "In alternative assessment, necessity is truly the mother of invention." Teachers often shared materials through cooperative planning and scheduling. Grant and incentive writing were used to obtain materials to support and extend the curriculum. Many teachers used school and community libraries for resource materials.

Study group members often found that they could rely on outside support from community members and parents. For example, a third grade teacher began a unit in math centered around a grocery store theme. When she found she was short on actual manipulatives, she asked her students to bring in one item from home to stock their store. Students brought in many items including personal toys. These items created an authentic activity that the teacher would normally teach for only one week, but because of student interest, the unit stretched into two weeks and incorporated goals for addition, subtraction, multiplication, and using money.

Negative perceptions were voiced in regard to the availability of equipment, supplies, materials, and space. Teaching materials that supported the assessment's objective were often not available. For example, one middle school teacher attempted to use videotaped interviews to evaluate student projects for a science assignment. Difficulties occurred in scheduling the use of the school's only video camera and in securing a quiet and uninterrupted taping location. Another teacher of the primary grades had difficulty finding a variety of tools for measurement (scales, meter sticks, graduated liter containers) to use in providing hands-on experiences. Teachers reported that money was not available for extra equipment and materials to support alternative assessment activities. Supplies and materials were often limited, non-existent, or out of date.

Cost and time may very well put the brakes to the alternative assessment movement. However, reviewing and discussing a portfolio with a child or watching that child perform a task adds a degree of intimacy that is revitalizing in an era characterized by a heavy reliance on depersonalized forms of assessment. One teacher summed up her feelings by saying, "There never seems to be enough time, but by using a rubric I have found I can grade reports and projects faster and more efficiently."

Teacher Effectiveness

Although members of the study group acknowledge that it is early in the project to evaluate the impact of alternative assessment on teacher effectiveness, many have already observed some evi-

dence, both positive and negative. Questions asked for this study were: "What feedback have you received on your effectiveness from your students? From your partner and other peers? From your principal?" and "How do you feel about your own effectiveness?" One teacher reflected on the ability to measure teacher effectiveness by student feedback: "Student grades and interest are improved by the use of alternative assessments, but is this truly a measure of our effectiveness? Students do not think in terms of teacher effectiveness, only student success. Can we equate these two?"

However, the majority of responses from the study group indicated that student reactions to classroom instruction were viewed by teachers as a reflection of their effectiveness. Therefore, many observations describe how students participating in alternative assessment activities reacted to the instruction. For instance, students who were included in the planning of assessments seemed to appreciate having a part to play in the evaluation process. Comments indicated that they particularly enjoyed the variety that alternative assessments added to the instruction. Alternative assessments were particularly effective for the more creative students. Special education students and their parents seemed especially appreciative of alternative assessment which plays to the strengths of individual students by providing them with a variety of methods to demonstrate mastery. A satisfied teacher commented, "I am thrilled with feedback I have received about using alternative assessments. My students' parents are happy because their children are happy and have become excited about learning and doing homework. I am aware of my effectiveness as a teacher because my students' grades have improved, and they stay on task." Several teachers expressed the belief that the students would retain more knowledge as a result of assessing their strengths instead of requiring conformity to the rigid criteria of traditional paper/pencil tests.

Teachers stated that they felt more effective as a result of being able to meet student needs by addressing various learning styles through the alternative assessments. They also enjoyed seeing the excitement evoked by hands-on activities. One teacher told of how she attempted to teach organizational skills and a linear approach to problem solving. Students had the option of reporting on their projects using photographs instead of written reports. One student had poor verbal ability, but was able to describe in photographs her bird feeder, illustrating effectively how the feeder was set up.

Teacher effectiveness with alternative assessment was affected by other variables. Administrative support can facilitate resource acquisition, planning time, and parent understanding and acceptance—crucial components of successful implementation of alternative assessment. Most administrators were very supportive and quite positive about the idea of using alternative assessment in their schools. However, a few administrators may have been uninformed about the initiative and, therefore, offered little support for implementation.

There were some negative comments heard from students. It was interesting that some of them came from students who performed well on traditional tests. For instance, these students felt that alternative methods only created extra work, were too time consuming, and were too difficult. Although no direct evidence of this was observed, some teachers were concerned that they might be required to defend the new methods to parents and expressed a desire to determine the effectiveness of the new procedures in comparison to traditional testing. However, since different aspects of learning are measured by the two methods of assessments, the use of control groups to experimentally determine the effectiveness of alternative assessment methods was not possible in this study group.

Overall, the teachers in this study group reported that the use of alternative assessment enhanced their effectiveness in teaching for learning, both academically and affectively. Teacher effectiveness was reflected in the observations that student achievement and attitudes improved for the majority of the students involved in the alternative assessment activities. One teacher said, "We are doing a better job of instruction and assessment of progress, but we have a long way to go." Another felt that, "I am still trying to find my way. Alternative assessment has added variety to my teaching methods." Yet another summed it up this way, "I feel that I have affected the effectiveness of my students."

Recommendations for Implementation

Study group members used five clarifying questions as prompts for discussion and reflection on alternative assessment. Topics for consideration included building a case for using alternative assessments, listing helpful resources, advising other teachers who are just beginning alternative assessments how to avoid major pitfalls, determining what did not work well, and providing suggestions to help teachers plan over the summer to incorporate alternative assessments into their teaching. Each member recorded responses that were analyzed by a pair of group members for commonalities and major points, then described for this section of *Alternative Assessments in Math and Science: Moving Toward a Moving Target*. The questions are given in Appendix G.

The following 10 recommendations were made by the members of this study group after six months of developing and implementing alternative assessment activities in their classrooms.

1. **Start small.** Follow someone else's example in the beginning, or do one activity in combination with a traditional test.

2. **Develop clear rubrics.** Realize that developing an effective rubric is harder than carrying out the activity. Standards and expectations must be clear. Benchmarks for levels of performance are essential. Characteristics of typical student products and performances may be used to generate performance assessment rubrics and standards for the class.

3. **Expect to use more time at first.** Developing and evaluating alternative assessments and their rubrics requires additional time until you and your students become comfortable with the method.

4. **Adapt existing curriculum.** Plan assessment as you plan instruction, not as an afterthought.

5. **Have a partner.** Sharing ideas and experiences with a colleague is beneficial to teachers and to students.

6. **Make a collection.** Look for examples of alternative assessments or activities that could be modified for your students and keep a file readily accessible. The National Teachers' Assessment Network provides one source of information.

7. **Assign a high value (grade) to the assessment.** Students need to see the experience as being important and worth their time. Make expectations clear in advance.

8. **Expect to learn by trial and error.** Be willing to take risks and learn from mistakes, just as we expect students to do. The best assessments are developed over time and with repeated use.

9. **Try peer assessment activities.** Relieve yourself of some grading responsibilities and in-

crease student evaluation skills and accountability by involving them in administering assessments.

10. **Don't give up.** If the first tries are not as successful as you had hoped, remember, this is new to the students, too. They can help you refine the process. Once you have tried an alternative assessment, reflect and evaluate the activities. Ask yourself some questions. What worked? What needs modification? What would I do differently? Would I use this activity again? How did the students respond? Did the end results justify the time spent? Did students learn from the activity?

Nine specific techniques to try when developing assessment activities are included in the list below.

1. **Group activities** encourage students to work together to develop a plan, carry it out, and communicate their findings to others.

2. **Logs and journals** provide an opportunity to brainstorm, to question, or to reflect on a problem.

3. **Nonroutine problems** involve creative problem-solving, critical thinking, and an innovative approach to the synthesis of ideas.

4. **Open-ended questions** probe students' ability to confront an unusual situation by applying a collection of strategies and ideas. These problems have a variety of correct responses.

5. **Student-generated questions** are formulated and written for other students and the teacher to solve.

6. **Performance tasks** consist of real-world problems that employ useful,meaningful applications for students to tackle.

7. **Portfolios** are collections of student work over time used to how overall improvement/ growth.

8. **Presentations**, single or group, explain ideas and information to others.

9. **Research projects** require students to find information not readily available in the classroom and to draw their own conclusions about implications.

The implementation of alternative assessment will be a growing, learning process for administrators, teachers, parents, and students. Although it may not replace all traditional testing, alternative assessment will strengthen instruction and learning, thereby addressing the issue of accountability in today's schools.

Sample Activities For Alternative Assessment

Introduction

How can we motivate all students to have a more positive attitude and greater involvement in all subject areas? How can we more effectively assess students who do not perform well on traditional paper and pencil tests? How can we assess all students' progress more realistically and meaningfully?

Alternative assessment activities may be a viable answer to all three questions. However, activities alone are not alternative forms of assessment. They are a part of instruction that facilitates learning. Assessment measures performance after skills have been practiced and once learning has occurred. When a student is given an activity in which to apply learning, informed of how performance will be evaluated, and then evaluated on that performance, the activity has become part of an assessment.

The rubric states the standard, or specific criteria, for the performance as related to the concept being studied so the student knows what is expected at each level as he/she advances toward mastery. Levels may range from novice to expert as students meet and exceed mastery of the objective. For example, the Kentucky performance assessments for statewide administration employ four levels: novice, apprentice, proficient, and distinguished. General descriptions of the levels range from "shows minimal understanding" to "offers insightful interpretations." (For a complete description, refer to the Rationale section of this document.) It has been observed that students can meet all of our expectations if they are given choices of the types of assessment activities, models of a final product, and clear performance standards to follow. In other words, a child can hit any target if he/she knows what it is and it is not moving.

Alternative assessment encourages individual creativity across the curriculum. The result is that, unlike most pencil and paper evaluations, alternative assessment increases student involvement, elevates self-esteem, and improves learning. Alternative assessments appear effective in evaluating student understanding of concepts while providing a welcome change for students and teachers alike. Students who do not adequately display their knowledge on a traditional paper/pencil test may find that alternative assessment activities address varied learning styles, providing a stage for learning performances that is more "user friendly." Assessments which match objectives and instruction enable students to demonstrate understanding of complex concepts while also providing opportunities for peer assessment and written and oral communication practice in all content areas.

The examples given in this section should serve as a stimuli for new approaches to measuring student achievement. Although these assessment activities were field tested in specific grade level classrooms, they can easily be adapted for use at other levels and with other subjects. It should be noted that in these first year attempts at alternative assessment, rubric development by study group members was at the novice level. This skill was more fully developed as the project continued into its second school year. Each activity provides the following information: **objective, grade, adaptations for other levels** (where appropriate), **subject, topic, materials, activity, rubric**, and **evaluation method** (who did what and how). In addition, side bar information is included for each activity

describing **time and preparation** requirements and **student/teacher analysis and reactions** to the assessment.

Once teachers are tuned in to using alternative assessment, it becomes easy to think of new and better ways to assess student learning. Every teacher has a unique style and techniques that can incorporate varied approaches to assessment. Use of a variety of assessment techniques broadens the scope of student competencies and applications teachers are able to assess completely and equitably within meaningful contexts.

Elementary Science and Mathematics Assessments

Activity 1: Weather Music

Objective: The learner will be able to demonstrate relevant connections between weather concepts and daily living in written form.

Grade: 4

Other Levels: Can be adapted for all levels. Rubric could require kindergarten students to draw instead of write. Primary students could limit the length of the writing or merely identify type of weather.

Subject: Science

Topic: Weather and music

Materials: audio tape with variety of weather sounds
listening center
tape deck with earphones for listening and taping
vocabulary list: weather words and sound words appropriate for the grade level.

Preparation and Time Required: Two days for students to listen to tape, write, read, and revise the paragraph for portfolio and display. Weather vocabulary and sound words with their meanings have been taught and practiced prior to this activity.

Analysis (Student/Teacher): "The music was scary. This is fun!"
This activity is one of many cross-curriculum activities for a unit on weather. A checklist could help students and teacher see progress daily. Be careful that students don't spend too much time listening to music. Activities address all learning styles.

Activity: The students listen individually or in small groups at a listening center to a tape of weather sounds. They identify the sounds heard and jot down thoughts about each sound that come to mind while listening to the weather tape. The students prewrite about what was heard by identifying and describing sounds using words from the vocabulary list. They then develop a paragraph describing the weather sounds. Points are given for words used correctly in a paragraph with supporting details describing and elaborating on the topic of weather. (Words have already been taught in previous lessons.) The students then read their paragraphs to the teacher or class while being audiotaped. Written paragraphs are included in a portfolio of creative writing samples and also copied for display with student illustration products.

Rubric: A four-point grading scale is used.

3 points = A Excellent; understands task, works independently, writes and reads a paragraph using all vocabulary words correctly with supporting details and description that clearly and concisely illustrate understanding and communicate ideas. Creates an attractive, unique illustration of the paragraph that corresponds to the context.

2 points = B Good; listens to tape, writes and reads paragraph using at least two thirds of the vocabulary words correctly with adequate supporting details and description that illustrate understanding and communicate ideas effectively. Illustrates the paragraph attractively and appropriately to complement the context.

1 point = C Fair; listens to tape, expresses thoughts orally using the vocabulary words, but uses only half the words correctly in writing with supporting details and description that illustrate understanding and communicate ideas. Illustrates the paragraph adequately.

0 points = D Needs Improvement; listens to tape, is unable to use two thirds of the vocabulary words orally or in writing. Supporting details and description are inadequate for illustrating understanding and communicating ideas. Illustrates the paragraph inappropriately or not at all.

Evaluation Methods:
Center checklist
Portfolio of best work
Display of stories and illustrations
Tape of oral readings

Activity 2: Earthworms Visit School

Objective: The learner will be able to demonstrate knowledge of earthworms and their behavior as well as skills in observations, graphing, and research.

Grade: 3

Other Levels: Suitable for any level. K-1 can keep picture journals or make picture flash cards to reinforce vocabulary. Grades two and up can write couplets or haiku.

Subject: Science

Topic: Animals Without Backbones

Materials:

- glass jars
- soil
- graph paper
- reference materials
- portfolios
- illustration materials
- tape recorder and tapes
- video recorder (optional)
- paper and pencils
- journals

Preparation and Time Required: Read *Henry and the Night Crawlers* from Henry Huggins. Read and discuss "Animals Without Backbones" in grade three science book. Two weeks of observation and activities.

Analysis (Student/Teacher): Are my worms moving?" "My mom got sick when she found worms under the rock!"

Activity: Students dig up earthworms from their lawns and under rocks. They place the earthworms in soil, study them, and use charts and graphs to record their behavior for two weeks. Assessment activities include: 1) researching and writing about earthworms, 2) using vocabulary, 3) developing charts or graphs, 4) composing creative writing pieces and poetry, and 5) illustrating.

Rubric: 4 points = A Excellent; makes chart or graph, demonstrates mastery of vocabulary, writes creatively and creates poems; reads, writes, and illustrates using reference materials.

3 points = B Good; keeps journal of observations, illustrates, completes four of five activities successfully.

2 points = C Fair; completes three of five activities successfully.

1 point = D; Needs Improvement; completes two of five activities successfully.

Evaluation Methods: Videotape (optional) and photograph the day the worms come to class and subsequent activities such as charting behavior. Record poems on students' audiotapes. Include poems and photographs in a portfolio with other creative writing, illustrations, and reports from reference materials. Evaluate vocabulary mastery by its use in writings and illustrations.

Activity 3: Fun at the Store

Objective: The learner will be able to demonstrate the use of money for buying and selling items in a store.

Grade: 3

Other Levels: First grade can do a teacher-directed activity. This is a good cooperative learning activity for grades two through five. Intermediate levels can incorporate multiplication and division.

Subject: Mathematics

Topic: Money

Materials: Empty food containers for three stores (grocery, drug, and toy)
paper and pencils
price tags
cash registers
play money
journals

Preparation and Time Required:
Day one: Categorize and price items for stores.
Day two: Make job tags. Discuss and practice job responsibilities with students.
Allow several days for students to work through the three centers.

Analysis (Student/Teacher): "This is fun! I understand why I need to learn how to count money."
Time management is a must with this activity. Involve students for active learning.

Activity: The class is divided into three cooperative learning teams. Four jobs are assigned randomly to members of the teams. The jobs are: cashier, customers, banker, and sales assistants. The banker distributes $5.00 to each team member except the cashier. Each team shops in one of the three stores. Each cashier is responsible for adding up all sales at each store. Each team member keeps a record of purchases and a running balance in his/her journal by subtracting from the $5.00 spending money. The customers' goal is to make as many purchases as possible with the least amount of money, staying within the budget.

Students must carry out the responsibilities of each of the four jobs, making a journal entry for each of the four roles and recording all transactions made. Students must include a summary of what was learned for each role in their journals. They must demonstrate the ability to count money, make change, and read andwrite money expressions correctly as they record transactions. Each team must report to the class on its activities telling what they did and what was learned.

Rubric: Excellent = Demonstrates a clear understanding of the use of money for buying and selling; quickly and efficiently counts money and makes change; accurately records money transactions; makes the most possible purchases with the least amount of money; and writes an insightful, clear, concise summary of learning.

Fair = Demonstrates some understanding of the use of money for buying and selling; counts money and makes change with some errors; records money transactions with some errors; is able to make purchases within the allotted budget; and summarizes learning verbally or in writing.

Needs Improvement = Demonstrates little understanding of the use of money for buying and selling; is unable to count money and/or make change; may record prices, but is unable to record expenditures and balances; exceeds the budget with purchases; and may be able to describe some learning verbally.

Evaluation Methods: Journal entries of transactions, running balances, and summaries of learning; team reports of activities; learning center checklist (three stores); and group cooperation.

Activity 4: Time Study

Objective: The learner will be able to demonstrate methods of recording the passage of time.

Grade: 3

Other Levels: Can be adapted for primary or intermediate levels.

Subject: Mathematics

Topic: Time

Materials:
- paper plates
- glue
- brads
- newspapers
- time-line models
- paper (construction or newsprint)
- encyclopedias
- paint/markers/crayons
- oak tag
- calendars
- magazines
- clock models

Preparation and Time Required: Prepare materials ahead of time. Teacher and students will determine how much time is needed for each task.

Analysis (Student/Teacher): "Look at my clock, it's the best!"
Bring in a collection of clocks as a motivational technique. Allow discussion and hands-on time. Discuss other methods of telling time such as sundials. How did people record the passage of time before clocks and calendars?

Activities: After studying time-lines, calendars, clocks, and other methods of recording the passage of time, students will:

1. Draw a time-line highlighting the major events in their lives to date.
2. Devise a weekly time schedule of personal activities using a calendar.
3. Design and build a free-standing clock or a paper plate clock to demonstrate times from weekly schedules.
4. Make a scrapbook of ways to tell time.

Each student will make an assessment wheel. Sections of the wheel will be colored in as the student completes the four tasks to track progress.

Rubric: Excellent = Demonstrates understanding of all of the tasks, works well independently and cooperatively, researches and locates information for construction of the products, presents information and products in a creative, clear, understandable manner; and demonstrates a firm grasp of the concept of time and the various methods of illustrating its passage.

Fair = Demonstrates understanding of most of the tasks, usually works well independently and cooperatively; locates some information for construction of the products, presents information and products in a clear, understandable manner; and demonstrates an acceptable grasp of the concept of time and the various methods of illustrating its passage.

Needs Improvement = Demonstrates understanding of few of the tasks, does not work well independently or cooperatively, locates very little information for construction of the products, presents information and products in an unclear manner, and demonstrates little grasp of the concept of time and the various methods of illustrating its passage.

Evaluation Methods: Display assessment wheels. Prizes may be given for the most original clock. Cooperative groups may work together to complete tasks. The rubric may be converted to a grading scale.

Activity 5: Life Cycle of a Plant

Objective: The learner will be able to demonstrate knowledge of the life cycle of a plant.

Grade: 3

Other Levels: K-1 students can identify four basic parts and draw a plant. Label plant parts by cutting and pasting under teacher direction.

Subject: Science

Topic: Plants

Materials:

- reference books
- flowering plants
- plants charts
- magnifying glass
- seeds
- journals, portfolios
- graph paper
- soil
- containers
- paper, pencil
- herbs
- magazines
- crayon/markers

Preparation and Time Required: Two days to set up center. Materials are gathered in advance. Completion of unit = two weeks, at 20 minutes per day.

Analysis (Student/Teacher): "I enjoyed visiting our imaginary garden to pick flowering plants." Students enjoyed active learning and taking part in assessing daily progress. This unit and the activities correlate beautifully with individual learning styles.

Activity: The teacher motivates the students by introducing the whole group to the plant center. The use of this center is discussed in advance and a visit planned with the class. Colorful displays make it inviting. Expectations are discussed and explained to the total group. Individual students are given guidelines to follow while working on each activity. (The center is a table area with plants, materials, and colorful displays.)

Student activities include:

1. Creating a story about seed growth.
2. Planting an herb garden. Graphing plant growth.
3. Creating a vocabulary game to learn new words.
4. Writing a couplet about a seed, plant, or flower.
5. Dissecting three different flowering plants and classifying each plant's parts.
6. Choosing a creative way to grow grass seeds and observe them, then explaining it to the class.
7. Planting a vegetable at home and recording daily journal entries on its growth and care. Drawing and labeling a diagram for inclusion in your portfolio.
8. Becoming an author of a plant picture book.
9. Planting two types of seeds, charting growth, and comparing results.
10. Reading five books about plants, listing titles and authors, and writing a summary to share your favorite with the class.

Rubric: Students keep a plant journal and retain their best work in a portfolio.

Each activity was graded holistically on a four point scale based on demonstrated understanding of plant life cycles, creativity, accurate and logical record keeping, and clear explanations or reports of products.

4 = Excellent

3 = Good

2 = Fair

1 = Needs Improvement

Evaluation Methods: Activity checklist, snapshots of plant growth, oral book reports, stories, graphs, diagrams, plant classifications, picture books, journal entries, portfolios, couplets, observations by the teacher, student reflections on learning.

Activity 6: What is the Weather?

Objective: The student will be able to demonstrate knowledge of weather patterns and bar graphs.

Grade: Can be adapted for any elementary level.

Subject: Science and math

Topic: Weather and bar graphs

Materials:

weather pictures	reference materials on weather
calendar	poster board
paper/pencils	weather forecast chart
grid paper	crayons or markers

Preparation and Time Required: Materials and models of final products should be gathered in advance. Students will need two days to construct graphs and a maximum of three minutes each to present their ideas.

Analysis (Students/Teacher): Additional products could be constructed based on the hypotheses set forth and the predictions made. This topic can be expanded into several activities such as vocabulary concentration, word scrambles, paraphrasing a poem about the weather, and researching weather instruments or cloud types.

Activity: After class discussion, the calendar person for the day tapes a picture on the weather calendar using one of four pictures (sunny, partly cloudy, cloudy, or rainy). Students record the daily weather for use in constructing a graph at the end of the month. Each student graphs the weather for the entire month using the bar graph format to show the frequency of occurrence for each of the four types of weather. The weather graph is then presented and explained to the class with a hypothesis and prediction about weather patterns. (See 7. of the rubric section.)

Rubric:

1. The graph must show the four types of weather across the bottom (the horizontal axis).
2. The number of days must be shown up the left side (the vertical axis).
3. The count must be accurate for the number of days per weather pattern.
4. Each bar representing one of the four types of weather must be a different color.
5. The numerals must be in ascending order and spaced at regular intervals on the graph.
6. Neatness and creativity should be present. For example, the bars may have an illustration of the types of weather, or may be three dimensional. Sloppy work will be evaluated as "needs improvement."
7. The oral presentation must communicate ideas about the weather clearly to the audience and explain how often weather patterns occurred during the month. Students should tell why they think the weather occurred as it did (seasons, hurricanes, etc.). Students should predict the weather for the next month based on information gathered during class study.

Excellent = Meets all seven standards. Demonstrates an in-depth knowledge of bar graphing. Communicates ideas clearly. Interprets the information to the audience to demonstrate knowledge of weather patterns. Explains a logical hypothesis about the weather occurrences and a logical prediction based on fact.

Fair = Meets five of the standards. Demonstrates an understanding of bar graphing and weather patterns. Communicates ideas and information to the audience adequately.

Needs Improvement = Meets four or fewer of the standards. Shows minimal understanding of bar graphing and weather patterns. Communication is not clear. Uses incorrect information. Graph is illegible.

Evaluation Methods: Students' graphs and presentations are judged based on the rubric. Classmates may also do evaluations of presentations for additional feedback. Graphs may be judged and awarded prizes. All graphs should be displayed.

Secondary Science Assessments
Activity 1: Essay Questions

Objective: The learner will be able to develop essay questions from the textbook chapter presently being studied.

Grade: Middle school

Other Levels: After instruction and practice on essay question formulation, this activity is adaptable to all levels after grade three.

Subject: Earth Science

Topic: Formulating essay questions

Materials: textbooks, paper, pencils, models

Preparation and Time Required: One week to develop the questions. Have models ready in advance for use with instruction on formulating essay questions.

Analysis (Students/Teacher): Students will need adequate prewriting instruction before attempting this task. This activity could be done in cooperative groups with one or two questions constructed per group to shorten the time requirement.

Activity: After appropriate instruction and practice in formulating essay questions based on main ideas and supporting details, students will construct ten questions from the chapter presently being studied. Questions should be open-ended and produce analytical explanations of the material and elicit organization of information. Answers should be written out on a separate paper with page numbers referenced. The questions developed by students will be used in inter-team and intra-team class competitions to be answered by other students and will be included on the chapter test.

Rubric: Questions must:

1. Total ten.
2. Include reference to the sections or subtitles in the chapter (when possible).
3. Be evenly distributed throughout the chapter.
4. Not require recall of minute detail.
5. Not require a sequential series answer.
6. Be open-ended.
7. Elicit organization of information from across the chapter.
8. Require analysis and explanation of the information.
9. Refer to the main ideas of the chapter.

Evaluation Methods: These questions make up 60 percent of the chapter test. They will also count for 90 points in the daily point total for each student. The questions developed by students will be used in inter-team and intra-team class competition.

Activity 2: Illustrating Speed and Acceleration

Objective: The learner will be able to illustrate speed and acceleration in a lab setting.

Grade: 8

Other Levels: Adaptable for grades six and above.

Subject: Physical Science

Topic: Speed and Acceleration

Materials: (per lab group)

- nylon string, 8 meters long
- 1 balloon, 9 inch diameter
- 1 meter stick
- 1 stop watch
- paper and pencil
- masking or scotch tape
- 1 two-inch drinking straw
- graph paper

Preparation and Time Required: Gather and prepare all materials in advance. Allow three days to a week to complete all activities.

Analysis (Student/Teacher): Students were very involved in racing their balloons and calculating speed and acceleration. Cooperative behavior should be taught in advance of lab work.

Activity: After a study of speed and acceleration, students are challenged to create their own illustration of the speed and acceleration of a balloon, given only the directions below. All materials are provided for the lab in order for the students to design and perform the lab in pairs.

Possible solution: Students should begin the lab by threading the string through the straw and tieing one end to a stationary object or holding both ends. The balloon is blown up and its opening held closed (the same student should blow up the balloon for each trial). The balloon is taped to the straw with the opening held toward the opposite direction of travel. When the balloon is released, the straw moves along the string. Students measure the distance the balloon traveled and the time required to travel that distance. At least three trials are run to collect and record data on the table. Calculations of speed and acceleration are made after measurements are taken.

Possible Data Table:

Trial	Distance (meters)	Time (seconds)
1		
2		
3		

Directions:

1. Illustrate the speed and acceleration of a balloon.
2. Design the lab and write out directions as you work.
3. Develop a data table to record data from any trials needed.
4. Develop a graph to illustrate the results.
5. Identify and describe the force that moves the balloon.
6. Describe the force(s) that works against the balloon.
7. Hypothesize the action of the balloon: a) in a vacuum, b) in space, c) on a planet with twice the mass of earth, d) on a planet with an atmosphere twice as dense as earth.
8. Describe where, when, or how the balloon moves in terms of inertia and Newton's First Law.
9. Explain where and how friction affects this experiment. How would the type of materials used affect the movement of the balloon?

Rubric: Lab assessment will be based on the following criteria:

1. Lab techniques—setup, measurements, behavior, effort, cooperation
2. Data collection—complete and measured in the proper units
3. Calculations—correct procedures and operations
4. Questions (above)—answered as completely as possible and fully explained in sentence form
5. Graphing—complete and correct
6. Illustrations and procedures—clear, concise, unique

Excellent = All criteria met. Creates unique illustrations and procedures and an imaginative solution. Understanding of the concepts of speed and acceleration is clearly and concisely illustrated.

Satisfactory = Illustrations and procedures are clear for the concepts. There are some minor flaws in calculations and/or answers to questions are correct, but not complete.

Passing = Illustrations and procedures are adequate for the concepts. There are several flaws in calculations and some lack of understanding of concept as evidenced by answers to questions.

Needs Improvement = Very little effort, inaccurate calculations, lack of understanding of the concepts.

Evaluation Methods: Students self-evaluate and peer-evaluate as the lab is conducted using the rubric criteria. The teacher does the final evaluation.

Activity 3: A Time-Line of Scientific Advancements and Historical Events

Objective: The learner will be able to demonstrate knowledge of connections between scientific advancements and historical events in other disciplines (political, economic, and literary) through the use of a time-line.

Grade: 8-10

Subject: Science

Topic: Advancements in the field of science and other disciplines

Materials: poster board
paper
markers
butcher paper or other roll paper

Suggested references:

Jacob Bronowski	"The Ascent of Man"
James Burke	"Connections"
Steven Gould	"The Panda's Thumb"
Jonathan Miller	"The Body in Question"
Philip Morrison	"The Line of Truth"

Preparation and Time Required: Gather reference materials and prepare models in advance. Allow one grading period for research, presentation of projects, and evaluation.

Analysis (Students/Teacher): Students were able to make relevant connections after dividing the century into manageable chunks and studying one decade at a time.

Activity: As an end-of-year group project and after reviewing the suggested references, students will construct a time-line that demonstrates an understanding of the interrelationships among scientific advancements and other disciplines: political, economic, and literary. Science events, data, and personalities should be included and correlated with politico-econo-literary events and personalities. Links between concurrent events should be included, e.g., stirrup/knights, penicillin/war, x-rays/medicine. Cross-disciplinary links must be explicitly stated, e.g., movable type led to the printing of books and a subsequent knowledge explosion with easy access to written information. Students will select the presentation method. Suggestions include posters, traditional time-lines, or narratives in paragraph form.

Rubric:

3 points = One event in each of the three content areas for each decade of the given century is included. Connections are clearly shown to scientific advancements of each decade.

2 points = Appropriate events are described, but connections to scientific advancements are weak and unclear.

1 point = Events are shown, but connections are not.

0 points = Improper events are described and no connections.

Evaluation Methods: Product/research report presentations to the class can be evaluated with the above scale by peers and teachers, or presentations can be made to a panel of teacher, student, and administrative representatives for feedback and evaluation.

Activity 4: Life of a Scientist

Objective: The learner will be able to demonstrate an appreciation for the value of the contributions of a scientist.

Grade: 11-12

Subject: Physical science

Topic: Scientists

Materials:
list of scientists
paper and pencil
construction paper or oak tag for cover
markers
reference materials
models

Preparation and Time Required: This is a nine-week project. Several class periods are required for library research. Gather reference materials and models in advance.

Analysis (Students/teacher): When first implemented, the rubric for this assessment was not specific enough. Students felt that just because they completed a part of the assignment, they deserved full credit regardless of the neatness, originality, or effort. This activity could be used in most subjects by changing the list of persons. Students were very positive about the reports. Most students received A's or B's and overall their grades improved. Several turned their projects in early and were very proud of the finished products.

Activity: Students will choose a scientist from those studied and create a scrapbook of the events in his/her life. The scrapbook will include a title page, a birth certificate, a newspaper article, a letter, and a time-line (see rubric). References should be cited.

Rubric: The scrapbook must contain the following items:

1. A title page including the name of the scientist, student name, and class period. 10 points
2. A birth certificate. 20 points
3. A one-page newspaper article reporting and explaining significant events in which your scientist was involved. 20 points
4. A one-page letter from the scientist to his/her teenager giving advice on how to succeed in the world today. 20 points
5. A time-line consisting of a chronological depiction of important events in the scientist's life. 20 points
6. References in proper format. 10 points

Note: The number of points awarded for each of the six components of the scrapbook will be affected by the following criteria:
-neatness
-originality and creativity, uniqueness
-effort and productivity

Evaluation Methods: Projects were turned in for teacher evaluation. Students could do a class presentation for extra credit.

Activity 5: Complex Machine Design

Objective: The learner will be able to demonstrate knowledge of complex machines by designing a complex machine using four simple machines.

Grade: 8

Subject: Physical Science

Topic: Complex machines

Materials:

paper and pencil	wheel on a wooden car
textbooks	door knob
ramp	rope eight meters long
stairs	crank on overhead projector
levers	tongs
scissors	measuring tape, metric units

Preparation and Time Requirements: Gather materials and models in advance. Students will need two days to complete the in-school investigations and one day for the take-home project.

Analysis (Students/Teacher): Students enjoyed working in pairs to complete the in-school activities and were able to peer evaluate during the exercise.

Activity: After completing the questions and calculations using the formulas and knowledge gained from chapter seven content on complex machines in class, students will design a complex machine using four simple machines.

Directions: Design a complex machine on paper using at least four simple machines. Your machine should be used to solve a problem and to perform a needed task or activity. State your problem or goal. Avoid using screws and wedges due to the friction involved. Identify the simple machines within your complex machine. Calculate the mechanical advantage of each of the simple machines and the overall mechanical advantage of the complex machine. Present your machine to the class explaining use and practicality.

Rubric: The points are awarded for each level.

1. Proper measurement techniques and accuracy, metric system used, correct units used, measurements written correctly. = 20 points
2. Proper formulas used for the measurements taken. = 15 points
3. Units are used when necessary. (work—Jouses) = 10 points
4. Mathematical operations performed properly. All work is shown. =15 points
5. Assignment is turned in on time and is as detailed as possible. Machine must be explained for use and practicality. = 20 points
6. Originality and creativity are evident in solving the problem. = 20 points

Evaluation Methods: Students design their complex machine at home using any resources they choose except another person. The complex machine design is explained to the class. The teacher completes all evaluation of products.

Activity 6: Investigating Density

Objective: The learner will be able to demonstrate understanding of lab procedures for density.

Grade: 10-12

Subject: General Chemistry

Topic: Density

Materials:

- graduated cylinder
- metric ruler
- data table
- water
- balance
- paper and pencils

Preparation and Time Required: One lab period. Gather materials in advance.

Analysis (Student/Teacher): This lab worked well to give students experience in developing their own procedure. At first they were disoriented, but as they made progress their lab confidence improved. This activity can be done in cooperative groups with one product per group.

Activity: This lab is conducted after a unit of study on density. Students are to find the density of four items: a block of wood, a cube of metal, an irregular solid (pebble), an unknown liquid, and an object of their choice. Students are given the above mentioned materials and must turn in a data table and the work showing how they determined the density of each item. No other specific instructions are given. They must develop their own procedure for conducting the lab work.

Rubric: 25 points each

1. The data table must be accurate according to density formulas and materials measured.
2. Students must show their procedures. Valid procedures are critical to this activity.
3. Conclusions must be logical and reasonable.
4) Students peer evaluate, then submit data table and peer evaluation to the teacher. Points are awarded for accurate peer evaluations.

Evaluation Methods: The data table is collected and graded according to the accuracy of the information given on density and the validity of the peer evaluations, procedures, and conclusions.

Activity 7: Field Guide to Mollusks

Objective: The learner will be able to demonstrate knowledge of mollusks by writing a field guide.

Grade: 11

Subject: Biology

Topic: Mollusks

Materials: reference materials, textbooks, notes, writing materials, Virginia Institute of Marine Science handouts, materials for constructing a booklet (oak tag, markers, etc.)

Preparation and Time Required: The criteria and rubric took minimal time to develop. This activity took a week for the students to prepare.

Analysis (Students/Teacher): I would definitely do this project again because the students liked it and they learned much about mollusks in the process.

Activity: This assessment should follow a unit of study on mollusks. Students are given the instructions at the beginning of the week-long unit in order to prepare for the project. Reference was made during class lectures, filmstrip viewing, discussions, etc., to this project and how class material could be applied to the project.

Directions: The Holt Publishing Company has assigned you to write a field guide on mollusks. A field guide is a small booklet that can be taken into the environment to identify and give information on organisms.

Rubric: The following information must be in your booklet to be published (in other words, to pass):

	Points
I. Number of species of mollusks and general characteristics	10
II. A look at ancestral mollusks	5
III. Body: Parts and functions (snail and clam)	20
A. Color diagram of internal body of a snail and clam	
B. Describe digestion and locomotion (movement) of each	
C. Excretion	
D. Respiration	
E. Circulatory system	
F. Reproduction and life cycle	
IV. Classes	10
A. Gastropods	
1. Torsion	
2. Without shells	
3. Examples	
a. Local	
b. Global	
B. Bivalves	10
1. Adaptation to a sedentary lifestyle	
2. Examples	10
a. Local	
b. Global	
C. Polyplacophora	8
1. Common name and habitat	
2. Adaptation to habitat	
3. Example	
D. Scaphopoda	7
1. Common name	
2. Example	
E. Cephalopoda	10
1. Extraordinary characteristics	
2. Locomotion	
3. Four examples	
V. Shells	10
A. What organ forms a shell?	
B. Name the three layers and characteristics of each.	
C. Diagram	
1. Gastropod	
2. Bivalve	
D. How are pearls formed?	

	Points
VI. Mankind's relationship with the phylum Molluska	10
A. Describe two harmful mollusks.	
B. Describe at least four mollusks used for food.	
C. Name two more beneficial mollusks that are not used for food.	
VII. Extra credit	
A. Tips on shell collecting	
B. Mollusk defense systems	
C. Extinction of the Bay Oysters (paragraph)	

The report must be typed or neatly handwritten on typing paper.

Points will be deducted for work that is not neat. All examples must include brief descriptions of the mollusk and its habitats and some interesting facts. Pictures must be in color. Information must be accurate.

Evaluation Methods: Criteria for evaluation of projects includes:

1. Accuracy of information
2. Spelling
3. Neatness
4. Detail of description
5. Information and habitat included in examples
6. Pictures (color, detail, accuracy)
7. Extra effort (extra information, attractiveness, creativity)

Activity 8: A Coral Reef Brochure

Objective: The learner will be able to demonstrate understanding of a coral reef and its inhabitants.

Grade: 11

Subject: Biology 1

Topic: Coral reef

Materials: 11" x 17" paper
markers, etc., for constructing a brochure
reference materials
videotape, "Australia—The Great Barrier Reef"

Preparation and Time Required: Allow up to a week to construct the brochure, depending on how much detail is required. One day or more is needed for presentation, depending on the number of students. Gather materials in advance.

Analysis (Students/Teacher): This was a fun project for the students. It was very easy to write the instructions and rubric. The projects were easy to grade and proved to be an excellent way to show the relationship between the video and the material studied in class on life in a coral reef.

Activity: After studying a unit on coral reef life and watching a videotape entitled "Australia—The Great Barrier Reef", the following assignment is given to students:

The Australian Board of Tourism has hired you to design and produce a tri-fold brochure on Australia's Great Barrier Reef to attract more visitors to the area. You will use your knowledge of a coral reef and its inhabitants to design the Great Barrier Reef brochure.

Rubric: The brochure must be in color on a tri-folded sheet of 11 x 17 paper. The brochure should include pictures of the area and/or organisms found in the coral reef (hand drawn, cut from map, computer generated, etc.). There must be a caption written for each picture and a paragraph to entice visitors. Quotes from the videotape must be included.

Brochure Criteria	Points
Color	10
Neatness	10
Accuracy	10
Use of quotes	10
Coral reef information	20
Pictures and Captions	20
Cover (title, your name; attractive, eye appealing "attention grabber")	10
Creativity	10

Presentation Criteria	Points
Useful information	20
Accurate content	20
Organization	10
Creativity	10
Audience awareness	10
Eye contact	10
Voice projection	10

Evaluation Methods: Students present to the class for peer and teacher evaluation using the above criteria.

Secondary Mathematics Assessments

Activity 1: Polygon Construction

Objective: The learner will be able to construct models of seven different types of polygons.

Grade: 7-10

Other Levels: This activity was also used with learning disabled students. The hands-on approach facilitated their learning.

Subject: Mathematics

Topic: Polygons

Materials:
- Cuisenaire rods
- strips of yard
- string
- popsicle sticks
- textbooks
- teacher's drawing

Preparation and Time Required: Gather example models and materials in advance of the lesson. Allow one week for instruction/review, building, and judging of presentations.

Analysis (Students/Teacher): Students learned from constructing the rubric and judging. This activity lends itself to cooperative group work.

Activity: Students use the textbook and the teacher's drawings on the board to review the different types of polygons (rectangles, triangles, parallelograms, etc.) that have been discussed and found in architecture, magazines, newspapers, and books. The students then devise a rubric that the class "Judging Team" would use to assess the models. Each student builds models of seven polygons. Finally a group of students serve as the "Judging Team" to evaluate models against the rubric. The "builders" communicate an explanation of their models using terminology from the lesson. The judging team assesses each student's performance based on the following:

1. Seven different types of polygons are to be represented.
2. Parallel lines are placed correctly in the models.
3. Acute, right, and obtuse angles are shown correctly.
4. "Builders" explain the polygons, lines, and angles using correct terminology.

Rubric:

Distinguished = Completes all models of polygons and communicates clearly the components with correct terminology; oral or narrative presentation is engaging and informative; offers generalizations to other applications (e.g., polygons in architecture of the school).

Proficient = Completes most components of the seven polygons and communicates the four objectives clearly; major concepts of the polygons are communicated with some missing/misunderstood information.

Apprentice = Completes some components of the four objectives; oral/narrative presentation is clear; gaps in knowledge/understanding are apparent; some reteaching required.

Novice = Minimal understanding of polygons is shown; communication is unclear or incorrect; objectives are not met; reteaching required.

Evaluation Methods: The judging team evaluated each performance with teacher guidance.

Activity 2: Science, Technology, and Society Project

Objective: The learner will be able to research an interdisciplinary problem (initiated in science class and involving mathematics and computer applications) by obtaining raw or published data for inductive analysis.

Grade: 10

Subjects: Mathematics, science, computer applications

Topic: Societal problem, global scale

Materials: research materials
computers and spreadsheets
paper and pencils
graph paper

Preparation and Time Required: Students prepared for the project during the second semester after research, statistics, and computer skills had been taught during first semester.

Analysis (Students/Teachers): This project could be done in cooperative groups with one product per group. The project can be evaluated with a rubric for science and for computer science, as well as for mathematics.

Activity:

Students are to choose an interdisciplinary global problem to study and offer a solution for. The project is initiated in science class with computer applications and math teachers assisting students and evaluating the product. Such topics as global warming, acid rain, and AIDS may be chosen. Students must obtain either raw or published data and samples on their subject, compile the data, conduct an inductive analysis, and display the findings by presenting the data and analysis.

Rubric: The following is the assessment scale for the **math** portion of this science, technology and society project. Points are earned as follows for all three sections:

A = 10 points
B = 9 points
C = 8 points
D = 7 points
E = 0 points

I. Data collection
   A. Data collected were sufficient to **fully** support the report's purpose.
   B. Data collected were sufficient to support the report's purpose, but minor omissions were noted.
   C. Data collected supported the report's purpose but more data was needed to prevent errors in the conclusions drawn.
   D. Quality/amount of data was questionable making reliable conclusions virtually impossible.
   E. No data was collected.

II. Spreadsheet
   A. Spreadsheet was thorough and data were presented in a clear, organized, and understandable manner. Calculations accurately supported the report's purpose.
   B. Spreadsheet was thorough but took some study to understand. Calculations were accurate, and all major items were present.
   C. Spreadsheet had some essential items missing, but generally valid conclusions could be drawn from calculations made.
   D. Spreadsheet had major items/calculations missing which could adversely affect the validity/thoroughness of the report's conclusions.
   E. Spreadsheet was either missing or completely ineffective in making an analysis of the data.

III. Descriptive statistics
   A. Graphs drawn were appropriate, thorough, easily read, and fully supported the report's purpose.

55 BEST COPY AVAILABLE

B. Graphs drawn were appropriate, thorough, but had minor omissions. They fully supported the report's purpose.
C. Graphs drawn were not appropriate in all instances. They lacked some thoroughness. Some did not support the report's purpose.
D. Graphs were difficult to read.
E. Graphs did not support the report's purpose.

IV. Frequency distribution
A. Frequency distributions were accurately presented. Comparisons were presented with box plots as appropriate.
B. Frequency distributions were appropriately presented with minor omissions.
C. Frequency distributions were presented with inaccuracies and/or box plots were omitted when they could have enhanced the report.
D. Frequency distributions presented were difficult to read and/or understand.
E. Frequency distributions were omitted when their presence could have enhanced the report and helped achieve its purpose.

V. Conclusions
A. Conclusions were thorough and accurate based on the evidence presented.
B. Conclusions were generally thorough and accurate.
C. Conclusions were somewhat speculative and did not in all instances reflect the evidence.
D. Conclusions were primarily speculative in nature and did not accurately reflect the evidence.
E. Conclusions were not provided.

VI. Inductive analysis
A. Inductive analysis was thorough, complete, and accurately reflected the data provided.
B. Inductive analysis was generally thorough and complete. Some minor items were omitted.
C. Some major inaccuracies were evident in the inductive analysis.
D. Inductive analysis was not appropriate to the situation.
E. An inductive analysis was not made and/or presented.

The following is the assessment scale for the **science** portion of this science, technology, and society project.

I. Statement of the problem
A. Problem was stated in a clear and concise manner.
B. Problem lacked some clarity but was sufficiently focused.
C. Problem statement was somewhat vague and/or wordy. It was somewhat difficult to determine the real purpose of the study.
D. Problem statement was vague to the point of being ambiguous.
E. The problem statement could not be understood or could not be found in the report.

II. Political/economic/social analysis of the problem
A. Competing interests were clearly stated and explained in a thorough manner. Subjects were well supported.
B. Competing interests were clearly stated, but support material was lacking in some instances.
C. Competing interests lack some clarity and/or support material was lacking in some instances.
D. Competing interests were vague and/or support material was lacking.
E. Competing interest discussions were confusing and did not support the report's purpose or there was little or no discussion.

III. Science of the problem
A. The scientific explanation of the problem was clear and well supported with diagrams, data, graphs, and mathematical formulae.
B. The scientific explanation of the problem was clear. Support material was not as thorough as could be expected and/or some essential diagrams, data, graphs, or mathematical formulae were missing.
C. The scientific explanation lacked clarity and some support material was missing.
D. The scientific explanation was vague and adequate support was missing.
E. The scientific explanation was very confusing and did not support the report's purpose, or a scientific explanation could not be found in the report.

IV. Alternative solutions
A. Alternative solutions were clear, thorough, and well supported by the background material and data in the report.
B. Alternative solutions were clear and thorough, but more support, data, and/or background ma-

terial could have enhanced the report.
C. Alternative solutions were not supported in all instances.
D. Some obvious alternative solutions were missing and/or some essential support material was missing.
E. Alternatives lacked clarity, and thoroughness and adequate support were missing or a discussion of alternative solutions could not be found in the report.

V. Recommended solution
A. The recommended solution was supported by the evidence presented and action agencies were thoroughly presented and clearly stated.
B. The recommended solution was supported by the evidence, but action agencies were not presented in every instance.
C. The recommended solution was not supported by the evidence in every instance.
D. The recommended solution was somewhat ambiguous and not clearly supported.
E. The recommended solution could not be found in the report.

The following is the assessment scale for the **computer applications** portion of the science, technology, and society project.

I. Title page
A. Title page reflected originality and creativity. The reader's attention and interest were immediately focused on the subject. The title of the project, the group's name, and the individual members' names were clearly visible.
B. Title page reflected creativity. The title of the project, the group's name, and the individual members' names were clearly visible.
C. Title page reflected some creative thought. The other basic requirements were clearly visible.
D. Title page reflected very little creative thought and/or some of the basic requirements were missing.
E. Title page contained inadequate information and no illustration or no title page was used.

II. Spreadsheet and/or data base
A. Spreadsheet or data base was used to compile the data. Data were well organized and titles were used to identify the data in an easily understood manner. Calculations were thorough, accurate, and appropriate.
B. Spreadsheet or data base was used to compile the data. Data were well organized and titles were used to identify the data in an easily understood manner. Calculations were thorough, accurate, and appropriate for the most part. A few minor errors were noted.
C. Spreadsheet or data base was used to compile the data. Data were organized and titles were used to identify the data. Calculations were thorough, accurate, and appropriate for the most part. Some errors were noted that could affect the conclusions in an adverse manner.
D. Spreadsheet or data base was used to compile the data. Data lacked organization and/or titles were missing in some instances making it difficult to accurately read the data. Errors of importance were noted in the report affecting the conclusion.
E. Data were not compiled using a spreadsheet or data base.

III. Word processing
A. Word processing was neat and well formatted. Graphs and other diagrams supported and illustrated the report in a well organized fashion. The report reflected professional work standards for style.
B. Word processing was neat with minor errors in formatting. Graphs and diagrams supported the report in an organized manner.
C. Word processing reflected several errors in format, organization, and/or style.
D. Word processing reflected many errors in format, organization, and/or style that detracted from the overall impression of the report.
E. Word processing reflected careless work, was not used to write this report, or the report was illegible.

IV. Oral presentation
A. The computer was used to assist the speaker during the presentation. Appropriate graphs and information were presented in an efficient and effective manner. Outlines of main points, tables, graphs, and other information were used by the presenter with the computer.
B. The computer was used to assist the speaker during the presentation. Appropriate graphs and other information were presented in an efficient and effective manner. Outlines of main

points, tables, graphs, and other information were used by the presenter with the computer. Only minor discrepancies were noted.

C. The computer was used to assist the speaker during the presentation. Appropriate graphs and information were presented in an efficient manner; however, the team did not use the computer to its fullest capacity to enhance the report.

D. The computer received minimal use during the presentation.

E. The computer was not used to assist the speaker.

V. Art work and/or graphics

A. Graphics and/or art work reflected creativity and significantly enhanced the clarity and effectiveness of the report. The use of graphics contributed to the visual appeal of the presentation while supporting the report.

B. Graphics and/or art work reflected creativity and significantly enhanced the effectiveness of the report.

C. Effective use of graphics and/or art work were reflected in this report.

D. There was little use of graphics and/or art work in the report.

E. There was no use of graphics and/or art work in the report.

Evaluation Methods: Student presentations of data, analysis, spreadsheet, descriptive statistics, frequency distribution, and conclusions were evaluated by a panel of science, math, and computer instructors.

Activity 3: Percentage Applications

Objective: The learner will be able to illustrate percentage rate of interest, total and part in percentage application problems using data from the newspaper.

Grade: 8

Other Levels: Applicable to high school levels

Subject: Mathematics

Topic: Percentages

Materials: newspapers, paper, pencil, assessment grid

Preparation and Time Required: Prepare the criteria and grids in advance. Allow time for writing problems and for checking, proofreading, and evaluating. By requiring that students complete a booklet of problems (each derived from a different section of the newspaper) the activity can reasonably require one or two weeks of instructional time.

Analysis (Student/Teacher): This is a good example of peer and self-evaluation for immediate feedback and improvement.

Activity: Students select data from sections of the newspaper to illustrate percentage rate, total and part in percentage application problems. Students make a booklet of data sources, leaving space to write and solve original percent application problems that require finding each of the three parts of the percentage equation (see criteria grid below). The rubric provides a self, peer, and instructor assessment grid to be completed. This assessment allows students to demonstrate their understanding of the wide variety of percentage applications and their use of percentage as a problem-solving strategy.

Rubric: Criteria Grid

✓ = Mastery

	Student	Peer	Teacher
1. Writes application problem.			
2. Identifies unknown.			
3. Translates to mathematical statement.			
4. Writes equation using ___% of___is___.			
5. Solves mathematical statement correctly.			
6. Uses mathematical terms correctly.			
7. Checks for accuracy and reasonableness.			
8. Writes solution in complete sentence.			

Evaluation Methods: Student checks off the grid to self assess, makes corrections, then shares the problem with a peer to evaluate. The teacher checks off the grid as a final evaluation. Points could be assigned to the criteria on the grid and equated with a grade, if necessary.

Activity 4: Lucky Seven

Objective: The learner will be able to determine the probability of randomly generating numbers between two and twelve using a pair of dice.

Grade: 8

Other Levels: Adaptable to any level.

Subject: Mathematics

Topic: Probability

Materials: one pair of dice for every two students, paper, pencils

Preparation and Time Required: Gather materials in advance. One class period to experiment with the activity, one period to work toward making more accurate predictions, and another class period to compare results and present to the class.

Analysis (Student/Teacher): Students were excited about this exercise and gained a great deal of knowledge about probability. No matter how good students thought they were at rolling certain numbers, the probability of rolling a seven proved to be greater than any other number when class tallies for rolling numbers were compared. The level of student involvement for this activity was very high.

Activity: Students take turns rolling a pair of dice until they roll seven. After the first roll (if it is not a seven), the students ask each other to predict the probability of rolling the same number again before rolling a seven. Each student keeps a tally of all numbers rolled and the number of correct predictions made. Tallies are compared within the class to determine if the likelihood of rolling any number can be accurately predicted. Students will write their interpretation of the principle of probability and apply it to a probability situation of their choice, such as flipping a coin, then present the results of their experimentation and compare them to the dice rolling.

Rubric:
4 points = 15-24 correct predictions
3 points = 10-14 correct predictions
2 points = 5-9 correct predictions
1 point = 0-4 correct predictions

Points are also earned for presenting comparison results and submitting an interpretation of the principle of probability.

Evaluation Methods: Students should be able to improve their ability to make predictions based on data collection and observation.

Activity 5: Creating a Word Problem

Objective: The learner will be able to demonstrate understanding of problem-solving strategies in mathematics by creating, illustrating, and solving a word problem.

Grade: 8-12

Other Levels: This activity can be used at any level with appropriate vocabulary.

Subject: Mathematics

Topic: Problem-solving

Materials: poster board
markers
construction paper
other art supplies as needed

Preparation and Time Required: Gather materials and models in advance. Project is done outside of class. Students need one week to prepare projects and presentation time in class.

Analysis (Students/Teacher): Students enjoyed creating a product to illustrate their word problems. The project was very effective for reinforcement of the concept. Cooperative groups could critique each other's work.

Activity: Students are to create a word problem based on an issue of concern to the student or from current events, design a poster that illustrates the problem and its solution, and present the project and solution to the class.

Rubric: Presentations will be evaluated on content, communication, and format according to the following rating scales and criteria.

I. Content scale
   A. In-depth understanding of concept, calculations are accurate and show all steps sequentially, problem clearly extends beyond scope of class examples.
   B. Thorough work, clear understanding of concept, calculations are accurate but some steps missing, problem patterned after class examples.
   C. Satisfactory work, minor inaccuracies in arithmetic calculations, problem mimics class examples closely.
   D. Problem attempted, shows little or no understanding of concept; portrays irrelevant ideas, major miscalculations or inaccuracies; elementary level problem (purely arithmetical or direct formula substitution).

II. Communication scale
   A. Presentation is original, dynamic, clever; goes beyond minimal requirements; evidence of considerable thought, effort, and time spent.
   B. Presentation is effective, clear, and organized; evidence of effort and time spent.
   C. Communicates successfully; sufficient but no elaborations; evidence of some effort and time spent.
   D. Minimally meets criteria; sloppy appearance; little effort or time spent evident.

III. Format/Mechanics criteria
   A. Meets minimum size requirement (10" x 14").
   B. Illustration appropriate to poster size or, if collage, covers entire surface area.
   C. Color use appropriate to theme, not just decorative.
   D. Neatly presented (lettering, illustrations, pictures cut out and attached, etc.).
   E. Page layout pleasing to the eye.
   F. Correct grammar and spelling.

Evaluation Methods: Presentations are assigned points based on the rubric scales and criteria for a final evaluation.

BEST COPY AVAILABLE

Activity 6: Constructing a Relay Network

Objective: The learner will be able to construct a map and graph of a relay network to illustrate algorithms.

Grade: 11-12

Subject: Mathematics

Topic: Algorithms, mapping

Materials: poster board, markers, other construction materials as needed, encyclopedia, atlas

Preparation and Time Required: Students need two weeks outside class to complete the project. One day in class is needed to complete oral presentations. Twenty minutes of class time is required for peer evaluation of projects.

Analysis (Students/Teacher): This activity was used in Advanced Topics in Contemporary Mathematics, a discrete mathematics course.

Activity: The student is to determine which method provides the minimum cost solution for providing a relay network between cities and then explain the solution to the class. The student will select a state whose major cities will provide the vertices of a relay network. Using an encyclopedia, atlas, etc., the student will locate the five or six cities with the largest populations and record the road mileage between those cities. On a poster, the student will draw the state and locate the cities. A complete graph will be drawn with the cities as vertices. The edges will be weighted with the mileage between cities. The student will then find the cost of providing a relay network between the cities using the road distances as costs. The cost must be determined and illustrated on the poster using 1) nearest neighbor, 2) sorted edges, and 3) Kruskal's algorithm. A brief presentation of findings will be made to the class and each student will complete a written peer evaluation of one project.

Rubric: Projects and presentations are evaluated on the following criteria.

1. State, cities, and complete graph accurately drawn. 25 points
2. Algorithms accurately illustrated and calculated to illustrate the most cost effective solution. 45 points
3. Neatness, creativity, use of color. 15 points
4. Clarity, organization, and originality of presentation. 15 points

Methods of Evaluation: The teacher evaluated each student's work and each student evaluated one other project. The peer evaluation counted as a quiz for the student completing the evaluation to motivate careful work.

The following is a form for peer evaluation.
Project belongs to _____

Evaluated by _____

For each item award 1 if the criteria is met and 0 if it is not.

____ 1. Poster meets size requirement (16"x 20").
____ 2. Map includes five or six cities.
____ 3. Complete graph is drawn including cities as vertices and edges weighted with mileage.
____ 4. Each algorithm is accurately illustrated and calculated by:
____ a. nearest neighbor
____ b. sorted edges
____ c. Kruskal's algorithm
____ 5. Minimum cost solution is clearly stated.
____ 6. Presentation is neat, creative, and colorful.
____ 7. Presentation is organized, original, and clearly communicated.
____ 8. Points for accurately evaluating another project are awarded by the teacher.

Activity 7: Scale Designs

Objective: The learner will be able to design a house plan or free standing sculpture and draw them to scale.

Grade: 10

Subject: Mathematics

Topic: Geometry

Materials: paper and pencils, graph paper, house plans, descriptions of outdoor sculptures

Preparation and Time Required: Class time is needed for discussion of sculptures and house plans prior to this activity. Gather materials, references, and representative models in advance. Students need one week to prepare and present projects.

Analysis (Students/Teacher): Students need information about local sculptures. The public library or local art league can provide resources. Newspapers publish house plans without scales. Students can measure a room side and set up a proportion to determine a scale.

Activity: After completing scale drawings of local sculptures and determining the scale factor for sample house plans, students will design a free standing sculpture or draw a home to scale.

1. You are an artist commissioned to design a free standing sculpture for a building in our community, such as WBHS, the Dominion Tower, etc. Draw a scale drawing of your creation using one-fourth inch equals one foot. Name the piece and name the building for which it was designed. Also name your commission price.

2. You are designing your own home. Show the house plans for the first floor of this 25' by 40' home. Use the scale one-fourth inch equals one foot. Be sure to include doorways, windows, kitchen sink, refrigerator placement, bathroom facilities, etc. Estimate a cost to construct your plan.

Rubric:

	Points:
1. Sculpture	
a. Name included	1
b. Location designated	1
c. Commission price included	1
d. Drawing is creative	2
e. Correct scale used	2
f. Neatness	2
g. Appropriate size in relation to building	1
h. Creativity	1
i. Visual interest	1
2. House plan	
a. Estimated cost	1
b. Correct scale used	2
3. Includes necessities (bathroom, kitchen, etc.)	2
4. Neatness	2
5. Creative, personalized, details added	1
6. Fuel efficiency	2
7. Convenience of lay out	2

Evaluation Methods: Students present their original project to the class and are evaluated by the above rubric.

Activity 8: Algebraic Alphabet

Objective: The learner will be able to demonstrate knowledge of a range of algebraic terms.

Grade: 10

Subject: Mathematics

Topic: Algebra

Materials: paper and pencils
markers and other materials desired for illustration

Preparation and Time Required: Construct the evaluation chart and gather materials and models in advance. Students need a week to construct the project and a day to present.

Analysis (Students/Teacher): This format can be used to review any content area vocabulary. The students enjoyed sharing their wild creations.

Activity: After study of selected vocabulary, the students will create an alphabet book and use it to explain "alphabet soup" algebra terms to younger students.

1. One page per letter of the alphabet
2. Algebraic term for the letter
3. Correct definition of the term
4. Illustration, diagram, or example of the term
5. Use creativity and imagination to compile the book.
6. Use color in the format and ensure that work is neatly done.
7. Prepare a brief oral presentation for the class as well as for a younger student.

Rubric:

		Points	Maximum Points
1.	Correct definition	1	26
2.	Accurate illustration, diagram, or example	1	26
3.	Creativity	1	26
4.	Format	.5	12
	a. Color		
	b. Front cover		
	c. Back cover		
	d. Binding		
	e. Pleasing to the eye		
	f. Well organized		
	Consistent presentation theme		
	h. Neatly presented		
	i. Evidence of time and effort		
	j. Use of pictures or illustrations		
	k. Original definitions, not copied from the glossary		
	l. Choice of terms and examples are helpful for exam study.		
5.	Oral presentation		10

Evaluation Methods: The teacher uses a project evaluation form for each student to score each page of the book and the presentation. Columns are used for the headings below. The presentation score is added to the bottom and totals are figured down and across.

Sample Alphabet Book Project Evaluation

Letter	Def.	Example	Creativity	Format	Comments
A					
B					
Totals					**Presentation Total Points**

BIBLIOGRAPHY

Alexander, L. (1987). *The nation's report card: Improving the assessment of student achievement.* Cambridge, MA: National Academy of Education.

American Association for the Advancement of Science. (1989). *Science for all Americans: A project 2061 report on literacy goals in science, mathematics, and technology.* Washington, DC: Oxford University Press.

American Association of Colleges for Teacher Education. (1991). Special briefing on assessment. *Briefs, 9*(17).

Archbald, D., & Newmann, F. (1988). *Beyond standardized testing: Assessing authentic academic achievement in the secondary school.* Reston, VA: National Association of Secondary School Principals.

Aschbacher, P. (1991). *Alternative assessment: State activity, interest, and concerns.* Los Angeles, CA: UCLA Center for Research on Evaluation, Standards, and Student Testing.

Baker, E., & Herman, J. (1983). Task structure design: Beyond linkage. *Journal of Educational Measurement, 20,* 149-164.

Baron, J. (1991). *Assessment, accountability, and the classroom teacher: What we are learning.* Paper presented at NEA State Affiliate Consortium. Washington, DC.

Bowers, B. C. (1989). *Alternatives to standardized educational assessment* (ERIC Digest No. EA 40). Eugene, OR: ERIC Clearinghouse on Educational Management.

Boyle, J. (1989). Perspective on evaluation. *Music Educators Journal, 76*(4), 22-25.

Bransford, J., & Stein, B. (1984). *The ideal problem solver: A guide for improving thinking, learning, and creativity.* New York: W. H. Freeman.

Bunce-Crim, M. (1992, March). Evaluation: Tracking daily progress. *Instructor,* pp. 24-26.

California Department of Education. (1991). *A sampler of mathematics assessment.* Sacramento, CA: Author.

Campione, J., & Brown, A. (1987). Linking dynamic assessment with school achievement. In C. S. Lids (Ed.), *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 82-115). New York: The Guilford Press.

Center for Children and Technology. (1992). Alternative assessment and technology. *Bank Street College of Education, 1*(3).

Charles, R., & Silver, E. (Eds.) (1989). *The teaching and assessing of mathematical problem solving* (Vol. 3). Reston, VA: Lawrence Erlbaum Associates and the National Council of Teachers of Mathematics.

Clarke, D. (1988). *Assessment alternatives in mathematics.* Canberra, Australia: Curriculum Development Center.

Cobb, P., et al. (1991, January). Assessment of a problem-centered second-grade mathematics project. *Journal for Research in Mathematics Education,* 3-29.

Collins, C. (1989). Grading practices that increase teacher effectiveness. *The Clearing House, 63*(4), 167-169.

Cryan, J. (1986). Evaluation: Plague or promise? *Childhood Education, 62*(5), 344-350.

Cushman, K. (Ed.). (1990). Performances and exhibitions: The demonstration of mastery. *Horace, 6*(3).

Denoyer, R., & White, M. (1990). Tests—fallible indicators of education quality. *NASSP Bulletin, 74*(523), 49-52.

Denton, J. (1989). Selecting an appropriate grading system, *The Clearing House, 63*(3), 107-110.

Educational Testing Service (ETS). (1987). *Learning by doing: A manual for teaching and assessing higher-order thinking in science and mathematics.* NAEP Report 17-HOS-80. Princeton, N. J.: Author.

FairTest, & NYPIRG. (1990). *Standardized tests and our children: A guide to testing reform in New York.* Cambridge and New York: National Center for Fair and Open Testing and New York Public Interest Research Center.

Feurerstein, R. (1979). *The dynamic assessment of retarded performers: The learning potential assessment device, theory, instruments, and techniques.* Baltimore: University Park Press.

Gardner, H. (1991). Assessment in context: The alternative to standardized testing. In B. Gifford & M. O'Conner (Eds.), *Future assessments: Changing views of aptitude, achievement, and instruction.* Boston: Kluwer Academic Publishers.

Giese, R., Cothran, J., & Rezba, R. (1989). *Students and research.* Debuque, IA: Kendall Hunt Publishing Company.

Haney, W. (1985). Making testing more educational. *Educational Leadership, 43*(2), 4-13.

Hibbard, K., & Baron, J. (1990, April). *Assessing students working in groups: Lessons from cooperative and collaborative learning.* Paper presented at the annual meeting of the American Educational Research Association. Boston, MA.

James, H., & Glaser, R. (1987). *The nation's report card: Improving the assessment of student achievement.* Report of the Study Group on the National Assessment of Educational Progress. Washington, DC: National Academy of Education.

Johnson, D., Maruyama, G., Johnson, R., Nelson, D., & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*, 47-62.

Johnson, S. (1990). *Teachers at work: Achieving success in our schools.* NY: Basic Books.

Kentucky Department of Education. (1992, August). *EdNews, 32*(6), S-2. Frankfort, KY: Author.

Kulm, G. (1991, May). Assessing higher order thinking in mathematics. *Journal for Research in Mathematics Education*, 252-256.

Lange, J. (1987). *Mathematics Insight and Meaning.* The Netherlands: OW & OC.

Lester, F., & Kroll, D. (1991, April). Evaluation: A new vision. *Mathematics Teacher*, 276-283.

Linn, R., Baker, E., & Dunbar, S. (1991). Complex performance-based assessment: Expectations and validation criteria. *Educational Researcher, 20*(8), pp. 15-21.

Maeroff, G. (1991). Assessing alternative assessment. *Phi Delta Kappan, 73*(4), 272-281.

Malehorn, H. (1984). Ten better measures than giving grades. *The Clearing House, 57*(5), 256-257.

Mann, K. (1988). Recognition programs for academic success: Improvement of achievement? *NASSP Bulletin, 72*(512), 101-102.

Mathematical Sciences Education Board. (1991). *For good measure: Principles and goals for mathematics assessment.* Washington, DC: The National Academy Press.

McClure, R., & Walters, J. (1992, April). *Alternative forms of student assessment.* Symposium presented at the annual meeting of the American Educational Research Association. San Francisco: AERA.

Miller, P., & Erickson, H. (1985). *Teacher-written student tests: A guide for planning, creating, administering, and assessing.* Washington, DC: National Education Association.

Mitchell, R. (1992). *Testing for learning: How new approaches to evaluation can improve American schools.* New York: The Free Press.

Muir, S., & Wells, C. (1983). Informal evaluation. *The social studies, 74*(3), 95-97.

National Center for Improving Science Education. (1989). *Science and technology education for the elementary years: Frameworks for curriculum and instruction.* Andover, MA, and Colorado Springs: Network, and the Biological Sciences Curriculum Study.

National Council of Teachers of Mathematics. (1988). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1990). *Teaching and learning mathematics in the 1990's.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1991a). *Mathematics assessment: Myths, models, good questions, and practical suggestions.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1991b). *MCTP assessment kit: Mathematics curriculum teaching program.* [Kit and videotapes]. Reston, VA: Author.

National Council of Teachers of Mathematics. (1991c). *Professional standards for teaching mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (1992, February). Assessment. [Special issue]. *Arithmetic Teacher.*

Negin, G. (1989). What test results don't reveal. *The Clearing House, 63*(3), 122-124.

Pandey, T. (1991). *A sampler of mathematics assessment.* Sacramento, CA: California Department of Education.

Peachman, E., & Wagner, S. (1990). *Mathematics assessment process for middle grades pilot project.* [Catalyst project, Center for Research in Mathematics and Science Education]. Raleigh, NC: North Carolina State University.

Perrone, V. (Ed.). (1991). *Expanding student assessment.* Alexandria, VA: Association for Supervision and Curriculum Development.

Phillips, G. (1990). State-by-state comparisons can benefit education. *Educational Leadership, 47*(7), 43-55.

Potter, E. (1985). "Good job!" How we evaluate children's work. *Childhood Education, 61*(3), 203-206.

Radacy, R. (1989). Evaluating student achievement. *Music Educators Journal, 76*(4), 30-33.

Regional Laboratory for Educational Improvement of the Northeast and Islands. (1992, January). Authentic assessment: The "trojan horse" of school reform. *The Regional Lab Reports.*

Resnick, D., & Resnick, L. (1988). Understanding achievement and acting to produce it: Some recommendations for the NAEP. *Phi Delta Kappan, 69*(8), 576-579.

Rief, L. (1990). Finding the value in evaluation: Self-assessment in a middle school classroom. *Educational Leadership, 47*(6), 24-29.

Schoenfeld, A. (Ed.). (1976). *Cognitive science and mathematics education.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Shepard, L. (1989). Why we need better assessments. *Educational Leadership, 46*(7), 4-9.

Sizer, T. (1985). *Horace's compromise: The dilemma of the American high school.* Boston: Houghton Mifflin.

Slavin, R. (1986a). *Ability grouping and student achievement in elementary schools: A best-evidence synthesis.* Baltimore: Johns Hopkins University, Center for Research on Elementary and Middle Schools.

Slavin, R. (1986b). *Using student team learning.* Baltimore: Johns Hopkins University, Center for Research on Elementary and Middle Schools

Smith, N., & White, W. (1988). The criterion and measurement problem in teaching. *Education, 108*(3), 385-392.

Stenmark, J. (1989). Assessment alternatives in mathematics: An overview of assessment techniques that promote learning. *EQUALS Assessment Booklet.* Berkeley, CA: University of California, Lawrence Hall of Science.

Stiggins, R. (1988). *Measuring thinking skills in the classroom.* Washington, DC: National Education Association.

Stiggins, R. (1988). Revitalizing Classroom Assessment: The highest instructional priority. *Phi Delta Kappan, 69*(5), 363-366.

Stiggins, R., & Conklin, N. (1992). *In teachers' hands: Investigating the practices of classroom assessment.* Albany, NY: State University of New York Press.

Thompson, A., & Briars, D. (1989, December). Assessing students' learning to inform teaching: The message in NCTM's evaluation standards. *Arithmetic Teacher,* 22-26.

Vermont Department of Education. (1991). *Counseling our future workforce.* Hampton, VA: Author.

Wiggins, G. (1987). Creating a thought-provoking curriculum. *American Educator, 11*(4), 10-17.

Wiggins, G. (1988a). Rational numbers: Toward grading and scoring that help rather than harm learning. *American Educator, 12*(4), 20-25.

Wiggins, G. (1988b). Ten "radical" suggestions for school reform. *Education Digest, 54*(3), 3-6.

Wiggins, G. (1989a). A true test: Toward more authentic and equitable assessment. *Phi Delta Kappan, 70*(9), 703-713.

Wiggins, G. (1989c). The futility of trying to teach everything of importance. *Educational Leadership, 47*(3), 44-48, 57-59.

Wiggins, G. (1991). Standards, not standardization: Evoking quality student work. *Educational Leadership, 48*(5), 18-25.

Willis, S. (1992, January). Mathematics education: Standards "revolution" takes hold. *ASCD Curriculum Update.*

Winograd, K. (1992). What fifth graders learn when they write their own math problems. *Educational Leadership, 49*(8), 64-67.

Winograd, S. (Ed.). (1992, August). The quest for higher standards. *Kentucky Department of Education EdNews,* 32(6) p. S-4.

Wood, K. (1992). Integrating the communication process with mathematics. *Middle School Journal,* 23(3), 55-68.

Wright, D. (1988). Teacher judgement in student evaluation: A comparison of grading methods. *Journal of Educational Research, 82*(1), 10-14.

APPENDICES

APPENDIX A

ARTICLE OF INVITATION TO MEMBERSHIP IN THE VIRGINIA STUDY GROUP

Teachers Sought to Study Future Course of Assessment

VEA—along with NEA and the State Department of Education and the Appalachia Educational Laboratory—is offering an opportunity to a select few teachers to help determine alternative forms of assessment.

If you answer "yes" to most of the following, call or write the VEA Instruction and Professional Development department of instruction for an application form.

- I teach science or mathematics either full- or part-time.
- I teach in elementary, middle, or high school.
- I like to write.
- I know/have used/want to learn about alternative forms of assessment like performance, portfolio, or projects.
- I have a friend in my building who meets the first four criteria and who would like to work with me on a project.
- My friend and I would like to participate in a two-year project to learn about alternative forms of assessment, to try out some examples in our math or science classrooms, to keep a record of what happens, and to teach some of our colleagues what we have learned.
- Our school division would support our participation with six days of professional leave between January and June, 1992.
- We would be able to meet three times between January and June with the full project team.

The association is seeking ten pairs of teachers (who both teach in the same building). The four sponsoring agencies will provide training in alternative assessment, help participants with implementation, and produce a report documenting the results of the project.

Applications are requested prior to November 30.

VEA News, Vol. 32, No. 2, October 1991.

APPENDIX B

STUDY GROUP MEMBER APPLICATION FORM

VEA-AEL-NEA-VDE Project on Alternative Assessment

The Appalachia Educational Laboratory (AEL), the Virginia Department of Education (VDE), and the National Education Association (NEA) are joining the Virginia Education Association (VEA) in a collaborative project to enable classroom teachers to develop, implement and disseminate their findings on alternative forms of assessment in science and mathematics.

Rationale. As it reconceptualizes K-12 education, the Virginia Board of Education is studying the issue of new assessment tools to measure student outcomes. While acknowledging that there is some utility to information derived from standardized, norm-referenced, multiple-choice tests, the Board has indicated its interest in other forms of assessment that yield more fruitful information about what students know and are able to do.

Because assessment results are used to make important decisions about students and schools, the information provided ought, to the greatest extent possible, to give direct evidence of actual performance. Alternative forms of assessment have the potential to provide better evidence of student performance.

The National Commission on Testing and Public Policy in its report, *From Gatekeeper to Gateway: Transforming Testing in America*, suggests that students should "supply answers, perform acts, demonstrate skills, create products, and supply portfolios" so that there are multiple sources of information upon which to base important decisions. This project is designed to explore these forms of assessment, especially performance, portfolios, and projects.

Questions. The following questions will guide the project:

- What alternative forms of assessment are best suited to instruction and how are they best implemented?
- What effect, if any, do alternative forms of assessment have on student achievement, student attitude, instructional practice, teacher efficacy, and teacher working conditions?
- What staff development activities are effective in enabling teachers to address assessment issues?

Participants. Ten pairs of teachers—each pair from the same school—will comprise the project group. The following criteria describe the kind of participants for whom the project is designed:

- teach science or mathematics either full- or part-time;
- teach in elementary, middle, or high school;
- like to write;
- know/have used/want to learn about alternative forms of assessment like performance, portfolio, or projects;
- have a colleague in the same school who meets the first 4 criteria and who would like to work on a project together;

- would like to participate in a two-year project to learn about alternative forms of assessment, field test several methods, keep a record of the change process, and teach some colleagues what was learned; and

- have a school division that would support participation with six days of professional leave for each partner between January and June 1992.

Activities. There will be three meetings of the study group between January and June 1992. Here is a synopsis of each meeting's program:

January 13-15: Outline project parameters and outcomes, review research, train and assist with skill practice in various alternative assessment methods, preparation for field testing strategies.

February 28: Assess progress, answer questions and concerns, refine practice, outline remaining tasks of the spring project.

May 4-5: Orient to data analysis and development of sections of report, begin writing tasks.

There will be another meeting in late summer to complete the report, refine practice, and plan the second year's activities.

Products. This two-year collaborative project will result in a 20-member "vanguard" of experts able to use and teach colleagues about alternative forms of assessment from early childhood to adolescent education. Th ill be available to provide staff development through association, local school division, AEL, and Department of Education events.

The interim publication, to be completed after the first year, will include implementation case studies that outline the approaches used and results achieved. With participant journals as their sources, these case studies will "tell the stories," giving highs and lows, dos and don'ts, obstacles and opportunities, cautions and commendations.

In the second year a series of videotapes will document what study group participants developed, how the assessment methods worked with students, and what happened when they shared their learnings with other teachers.

An evaluation report at the end of the two-year project will summarize what was learned about developing, implementing, and disseminating information about alternative assessment methods.

VEA-AEL-NEA-VDE Alternative Assessment Study Group Member Application Form

Send **this completed application with that of your partner** to Alternative Assessment Study Group, VEA, 116 S. 3rd St., Richmond, VA 23219 no later than December 2, 1991.

Name _____

Home Address _____

_____

Home Phone _____

School Name _____

School Address _____

_____

Local Association _____

Teaching Position and Subject _____

VEA Membership Type _____

Partner's Name _____

Principal's Name _____

Principal's Signature (indicating support for the pair's participation in the first year of the study group project through the provision of six days of professional leave between January and June, 1992 for meeting/training attendance)

Answer the following questions on a separate sheet and attach to this page.

1. Study group members will receive training on a variety of alternative assessment measures. Each will be asked to field test and monitor progress of one or two strategies with their math or science students. Please describe any experience you have with alternative assessment measures like performance, portfolios, or projects.
2. In the first year project participation will involve (with the assistance of VEA, AEL, and VDE staff) reviewing research, field testing alternative assessment methods, analyzing data, developing sections of a report, and peer editing the publication. Writing will be a major study group activity. Please describe your writing experience. Include specific information about publications, workshops, and/or courses, if applicable. Attach a sample of your writing to this application.
3. Study group members will work in pairs at their schools to observe and be observed implementing these measures. Giving and accepting feedback will be important to each member, student, and project success. What experiences have prepared you to be a partner in this action research project?
4. Please respond "yes" or "no" to the left of the following descriptors of project members.

___ I teach science or mathematics full- or part-time,

___ I teach in elementary, middle, or high school,

___ I like to write,

___ I know, have used, and/or want to learn more about alternative forms of assessment such as portfolios, performances, or projects,

___ I have identified a colleague in my school who is willing to work with me as a study group member pair,

___ I can secure six days of professional leave for training and meeting participation between January and June 1992.

Applications and writing samples are due to VEA no later than December 2, 1991. Please send to Alternative Assessment Project, VEA, 116 S. 3rd St., Richmond, VA 23219.

APPENDIX C

GLOSSARY OF TERMS FOR ALTERNATIVE ASSESSMENT

Alternative Assessment (also known as "authentic assessment" or "performance-based assessment")—items or tasks that require students to apply knowledge in real-world situations

Benchmark—a sample of work that illustrates a category or score on a scoring rubric

Criteria—the aspects of a performance that should be considered in evaluating that performance

Holistic Scoring—a scoring process in which a score is based on an overall impression of a finished product compared to an agreed-upon standard with specific completion criteria for that task. Essential to holistic scoring is how all traits are interwoven to produce the final product.

Open-response Items—items requiring short written answers versus one-word, multiple choice, true/false, etc.

Performance Event (or performance task)—assessment task that requires students to apply what they have learned

Personal Communication—conference or interview by one or more persons with a student to assess the level of knowledge or skill attainment

Portfolio—a representative collection of a student's work over time, including some evidence that the student has evaluated the quality of his or her own work

Problem Solving—the integration of creative and critical thinking processes with communication and study skills in order to develop an effective solution

Product—a physical representation of the application of knowledge or skills to demonstrate competency according to established standards

Real-world Problems—meaningful applications of skills within actual or simulated events that may occur in life experiences

Rubric—a set of scoring guidelines that can be used to evaluate students' work, usually with benchmarks illustrating levels of competency

Kentucky Department of Education. (1992, August). Glossary: Do you speak 'assessment'? *EdNews* 32(6). p. S-12.

APPENDIX D

CRITERIA FOR QUALITY ALTERNATIVE ASSESSMENT

Consequences

Does the tool have positive consequences, or are there unintended effects such as narrowing of curriculum, adverse effects on disadvantaged students, etc?

Fairness

Does the tool consider fairly the cultural background of those students taking the test? Have all students had equal opportunity to learn the complex thinking and problem-solving skills which are the targets of these new assessments?

Transfer and Generalizability

Are the results reliable across raters and consistent in meaning across locales? Do results from a partial range of knowledge (e.g., narrative or imaginative writing) give information about the whole domain of knowledge (e.g., writing)?

Cognitive Complexity

Does the tool actually assess higher-level thinking skills?

Content Quality

Does the tool reflect and draw on critical, enduring aspects of content?

Content Coverage

Do the assessment tasks represent the big ideas of a full, integrated curriculum?

Meaningfulness

Does the tool engage students in meaningful problems, resulting in worthwhile educational experiences and greater motivation for performance?

Cost and Efficiency

Has sufficient attention been given to efficient data collection designs and scoring procedures?

(Linn, Baker and Dunbar, 1991)

Appendix E

Qualitative Assessment Instruments for Findings: Content Category Questions for Consideration By Study Group Members

I. Student achievement and attitude
   - A. What do I see?
   - B. What can students do?
   - C. What do students tell me about it?

II. Instructional practice
   - A. How have your teaching methods changed as you have implemented alternative assessments?
   - B. What are you doing differently?

III. Teacher effectiveness
   - A. What feedback have you received on your effectiveness from your students?
   - B. What feedback have you received on your effectiveness from your partner and other peers?
   - C. What feedback have you received from your principal about your effectiveness?
   - D. How do you feel about your own effectiveness?

IV. Working conditions
   - A. What has helped or hindered your project in relation to the following essential conditions for successful implementation in school settings?
     1. Time for learning, sharing, and peer assistance
     2. Administrative support
     3. Resources for supplies, materials, or equipment

APPENDIX F

WEEKLY SUMMARY SHEET
FOR STUDY GROUP MEMBER REFLECTION

Date _____

Name _____

Please summarize the most significant event or experience you had in these areas this week.

Student Achievement

Student Attitude

Instructional Practice

Teaching Effectiveness

Working Conditions

Working with your partner

Other thoughts

Appendix G

Qualitative Assessment Instruments for Recommendations: Five Implementation Questions for Consideration By Study Group Members

1. Based on the experience you have had so far, build a case for using alternative assessment in the classroom. That is, why is alternative assessment a good idea?

2. Of all the resources (books, articles, people, other) you have worked with, which were the truly helpful ones?

3. What would you tell other teachers who are starting out to help them avoid major pitfalls?

4. Knowing what you know now, what would you do differently? What have you learned did not work well?

5. What suggestions do you have to help teachers plan over the summer to begin incorporating alternative assessment into their teaching in the fall? How could they best use the summer time?